DOCUMENT RESUME

ED 050 385 24 CG 006 389

AUTHOR	Pender, Nola J.
TITLE	A Developmental Study of Conceptual, Semantic Differential, and Acoustical Dimensions as Encoding Categories in Short-Term Memory. Final Report.
INSTITUTION	Northwestern Univ., Evanston, Ill.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO	BR-9-E-070
PUB DATE	Oct 69
GRANT	OEG-5-9-235070-0045-(010)
NOTE	105p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$6.58
DESCRIPTORS	*Acoustics, Adult Learning, Grade 2, Grade 6, *Learning Processes, *Memory, *Recall (Psychological), *Semantics

ABSTRACT

The purpose of this research was to investigate developmental changes in encoding processes. It attempted to determine the extent to which children of varying ages utilize semantic (denotative or connotative) and acoustical encoding categories in a short-term memory task. It appears to be a reasonable assumption that as associational hierarchies become more complex and category distinctions become more precisely defined, encoding processes will also manifest definite modifications. The assumption underlying the present research is that when a person hears a word he encodes it into a number of different psychological categories. When a number of words are encoded into the same category within a short period of time, inter-item interference occurs and depresses recall. If a subsequent group of words are coded into a different category, inter-item interference is minimized and recall is facilitated. (Author)

BR 9-E-070
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ED050385

FINAL REPORT
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A DEVELOPMENTAL STUDY OF CONCEPTUAL, SEMANTIC DIFFERENTIAL, AND ACOUSTICAL DIMENSIONS AS ENCODING CATEGORIES IN SHORT-TERM MEMORY

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The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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ABSTRACT

Statement of Problem

The purpose of this research was to investigate developmental changes in encoding processes. It attempted to determine the extent to which children of varying ages utilize semantic (denotative or connotative) and acoustical encoding categories in a short-term memory task. It appears to be a reasonable assumption that as associational hierarchies become more complex and category distinctions become more precisely defined, encoding processes will also manifest definite modifications.

The assumption underlying the present research is that when a person hears a word he encodes it into a number of different psychological categories. When a number of words are encoded into the same category within a short period of time, inter-item interference occurs depressing recall. If a subsequent group of words are coded into a different category, inter-item interference is minimized and recall is facilitated.

Procedures

Five dimensions were selected for investigation as to their use as encoding categories in the learning task. These dimensions were Conceptual class, the Semantic Differential dimensions of Evaluation, Potency, and Activity, and Acoustical similarity. Fifteen words were

selected from four different conceptual classes. Each group of 15 words was arranged into five word triads. Eighteen words were selected from each end of the three Semantic Differential dimensions and these were arranged in six word triads. In the Rhyme dimension, 15 words were selected that rhymed with "blue" and 15 other words were selected that rhymed with "care". Each group of 15 words was arranged into five triads.

The learning task was presented auditorially. Each S̲ was given a word triad on each trial. He was given five seconds to repeat the three words before the retention interval began. The 15 second retention interval was filled with numeral reading at a rate of one numeral per second. When a tone sounded, the S̲ was asked to recall the three words that had been presented. This continued for five or six trials depending on the dimension.

On all trials preceding the last trial, the experimental S̲s were given words that were homogeneous with regard to conceptual class, placement within the Semantic Differential dimension, or acoustical sound. On the last trial, the experimental S̲s shifted to another conceptual class, the opposite end of the Semantic Differential dimension, or words with a different acoustical sound. It was hypothesized that if the S̲s were encoding on the dimension being manipulated, the shift on the last trial would result in an increment in recall performance since inter-item interference had been minimized. The control S̲s continued on the same homogeneous class across all trials and should have exhibited a decrement throughout the learning task. Second- and

sixth-grade students were used with an adult group added in the Rhyme dimension.

Results

When the decrement in performance over pre-shift trials was examined, the largest decrement occurred in the Conceptual, Evaluation, and Rhyme dimensions. This indicated a higher degree of inter-item interference in these dimensions than in the dimensions of Activity and Potency. When the performance on the shift trial was compared with performance on the pre-shift trial, release from proactive inhibition was significant only in the Concept, Evaluation, and Rhyme dimensions. It appeared that conceptual class, the negative and positive ends of the Evaluation dimension of the Semantic Differential, and differing acoustical sounds represent different encoding categories in short-term memory. The frequency of acoustical encoding appeared to decrease with age. The adult Ss exhibited little PI build-up and subsequently little release was apparent. Second- and sixth-grade Ss exhibited approximately the same frequency of acoustical encoding.

Conclusions

It appeared that both second- and sixth-grade Ss encoded words in the learning task by conceptual class, polarization on the Evaluation dimension of the Semantic Differential, and by acoustical characteristics. The Semantic Differential dimensions of Potency and Activity did not emerge as functional encoding categories in the learning tasks presented.

The findings added further support to the assumption that words encoded into the same category produce interference in recall. A change in encoding category decreases inter-item interference and facilitates recall.

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A DEVELOPMENTAL STUDY OF CONCEPTUAL, SEMANTIC DIFFERENTIAL, AND ACOUSTICAL DIMENSIONS AS ENCODING CATEGORIES IN SHORT-TERM MEMORY

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The research presented in this paper investigated developmental changes in encoding processes. More specifically, it attempted to determine the extent to which children of varying ages utilize semantic (denotative or connotative) and acoustical encoding categories in a short-term memory (STM) task. Developmental changes in other verbal processes such as mediation and concept learning have been demonstrated in a number of studies where the chronological age of the subjects (Ss) was varied (Kuenne, 1946; Kendler, 1963; and Osler, 1966). It appears to be a reasonable assumption that as associational hierarchies become more complex and category or class distinctions become more precisely defined, encoding processes will also manifest definite modifications. It is possible that alterations in encoding processes may underlie the changes found developmentally in mediational and conceptual behavior.

The present research was based upon the assumption that when a person hears or sees a word, he encodes it into a number of different psychological categories based on its meaning or other distinctive attributes. For instance, if the word "dog" is presented, it may be encoded not only in the dog category but also in the categories of animal, four-footed creature, and pet. A single word may be encoded into many different categories or dimensions.

Wickens, Born, and Allen (1963) suggested that encoding a number of words into the same category within a short period of time may produce interference and depress recall. The decrement in recall in a Peterson and Peterson-type STM task as a function of the number of preceding items (proactive inhibition) may be dependent upon the class of materials used. To test their hypothesis, Wickens and his associates gave one group of Ss a consonant syllable (CCC) triad on each of three trials with recall tested after an 11 second interval. On the fourth trial, the Ss were shifted to a triad of numbers (NNNs). Another group began with NNNs and shifted to CCCs. A control group remained on the same class of materials across all four trials. The experimental group was significantly superior to the control group on the shift trial.

Generalizing from these findings, the investigators concluded that in the STM situation all items which are homogeneous with respect to a psychological class are encoded not only as unique items but also as members of the same psychological class. When items are drawn from the same class for several trials, interference occurs producing a decrement in performance. If items on a subsequent trial are drawn from a different class, interference is reduced and performance on that trial is facilitated.

Loess (1967) also demonstrated the same build-up and release from PI when he presented Ss with three successive items from one taxonomic category (countries, musical instruments, etc.) followed by three items from another category. This continued for eight categories with only one item presented on each trial. The saw-tooth appearance of the recall data suggested that each word was encoded as a member of a superordinate class with release from proactive inhibition (PI) apparent when a new class was introduced.

Encoding in STM on a number of different dimensions has been explored using the Wickens, Born, and Allen technique. Several of these studies will be reviewed to serve as a background for the research presented in this paper. One of the early experiments was that of Clark and Wickens (1966) in which they investigated the effect of a shift in the verbal connotation of items on a single trial following the build-up of PI on previous trials in which all of the items presented were highly similar in verbal connotation. Connotation was based on the Evaluation, Potency, and Activity dimensions of the Semantic Differential (Osgood, Suci, and Tannebaum, 1957). The Evaluation dimension emerges from a good-bad descriptive scale of common words, Potency from a strong-weak descriptive scale, and Activity from a fast-slow descriptive scale. If the opposite ends of each scale represent different classes in STM storage, the build-up of PI over several trials should be reduced by a shift from one end of the scale to the other end. The Ss were given a word triad from the same end of the Semantic Differential scale on each of the four pre-shift trials with recall required after a 15 second retention interval. When a word triad from the opposite end of the scale was presented on the shift trial, the performance of the experimental groups in all three dimensions was reliably superior to that of the control groups.

Underwood and Richardson (1956) presented Ss with a number of words, asking them to respond at a sensory rather than a meaningfulness level. Reutener (unpublished) used the stimulus words which had elicited the sensory responses "round" and "white" to determine if sensory dimensions served as encoding categories in STM. Examples of the "round" category are barrel, knob, and donut. Examples of the "white" category are linen, chalk, and salt. After four trials in which a triad of three "round" words was presented on each trial, one experimental group was shifted to the "white" dimension. Another experimental group was shifted from the "white" to the "round" dimension. The control group continued on the same sensory dimension throughout the learning task. The experimental groups performed significantly better on the shift trial than did the control groups.

Grammatical class as an encoding category in STM was investigated by Wickens, Clark, Hill, and Wittlinger (in press). Verbs and adjectives served as the learning materials, the shift being made in both directions between the two grammatical classes for different experimental groups. When word frequency and length were controlled and semantic and phonetic uniqueness within each grammatical class was avoided, there was no evidence of release from PI on the shift trial. The performance of the experimental and control groups was parallel.

The investigators concluded that grammatical class was not a prominent encoding category in STM.

The importance of acoustic as opposed to semantic encoding in STM was explored by Wickens and Simpson (in press). The items on each trial preceding the shift trial were three spelled-out numbers. The retention interval task was 20 seconds of color naming. On the shift trial, the two sets of items presented to the experimental and control groups were acoustically identical but dissimilar conceptually (Experimental - ate, too, won; Control - eight, two, one). The experimental group performed reliably better than the control group on the shift trial. Semantic factors appeared to override acoustical similarity in this experiment resulting in release from PI in the experimental group.

Wickens and Eckler (1968) further substantiated the findings of Wickens and Simpson by using words which were homophonic with letters as their learning materials. After PI build-up across three trials with CCC trigrams, the experimental group was given a word triad such as Pea, Kay, Bee which was acoustically identical to the CCC trigram given the control group (P, K, B) but semantically different. The experimental group showed a significant improvement on the shift trial resulting in recall performance that was superior to that of the control group.

The results of the above studies using the Wickens, Born, and Allen technique have indicated that when integrated, meaningful units such as words are used in a STM task, semantic dimensions of encoding become more important than acoustical dimensions. Adults appear to encode on the Evaluation, Potency, and Activity dimensions of the Semantic Differential, on taxonomic category, on sensory impression, but not on grammatical class.

The release from PI research strategy used in these experiments is straight-forward, involving the selection of two groups of words that constitute logical categories based on linguistic rules. Triads of words are selected from one class and the S is asked to recall one triad on each trial for three to five trials. On the shift trial, a triad from the other class is presented. If a marked decline in recall occurs over the pre-shift trials it can be assumed that the items are coded into a common category. An increment in performance on the shift trial undoubtedly indicates that the items in this triad represent a different psychological class. The Wickens, Born, and Allen technique will be used in the present study to determine the frequency of encoding by taxonomic category, by the Semantic Differential dimensions of Evaluation, Potency, and Activity, and by acoustical characteristics at different age levels.

Encoding Based on Conceptual Category

Loess (1967) provided empirical evidence that adult Ss encode words in a STM task according to conceptual category. It is the purpose of the first experiment to determine if the frequency of encoding according to conceptual category increases with chronological age.

Predictions. When word association data of young children (Entwisle, 1966) are examined, a larger number of conceptual responses occur at the fifth-grade than at the first- or third-grade levels. For instance, when the word "bee" was presented, "insect" was given as a response by one first-grade S, 22 third-grade Ss, and 46 fifth-grade Ss. The word "color" was given as a response to the word "black" by six first-grade Ss, 23 third-grade Ss, and 51 fifth-grade Ss. These are only two of the instances which illustrate this general trend in children's word association norms. These data appear to indicate that the degree of conceptual encoding may increase developmentally. If such is the case, greater PI build-up should occur at the sixth-grade than at the second-grade level over trials of items from the same conceptual class. Second-grade Ss may be encoding items on acoustical or graphemic features rather than on semantic dimensions. Sixth-grade Ss in the experimental (E) group should exhibit greater release from PI on the shift trial than the second-grade E Ss unless a ceiling effect occurs which does not permit the full degree of release from PI to emerge.

Method

Design. The Ss were divided into 16 groups of 10 Ss each based on two grade levels (second- and sixth-grade), two treatments (experimental and control), and four different conceptual changes for the E group on the shift trial (animal to body part, body part to animal, clothing to vegetable, and vegetable to clothing). A repeated measures design was employed with each S being given a score based on the number of words correctly recalled on each trial. Position of the words in the recall protocol was not taken into consideration in the scoring.

Subjects. The Ss were 80 second-grade and 80 sixth-grade students from the DeKalb Unit School District and the Northern Illinois University Laboratory School, DeKalb, Illinois; and the Sycamore Unit School District, Sycamore, Illinois. Subjects were provided by nine elementary schools and two middle schools. All of the Ss were required to participate by their teachers. The 80 Ss from each grade level used in this experiment were randomly drawn from a pool of 400 second-grade and 400 sixth-grade students which served as the source of Ss for all of the experiments conducted within this study. Each S was tested individually by the author in a small room within each school. This room was usually the special reading room or the speech room.

Materials. Fifteen words were selected from each of the conceptual categories: animal, body part, vegetable, and clothing. Since it was essential that the concepts presented be familiar to the second-grade Ss, selection was based on the word frequency count which appears in A Basic Vocabulary of Elementary School Children by Henry D. Rinsland. This word count was conducted using a large sample of children's writings. For the lower grades, reports of children's conversation provided by elementary school teachers were also included. Frequency of occurrence was reported by grade for

Grade 1 through Grade 8. The reported frequencies undoubtedly represent a conservative estimate of the available vocabulary at each grade level since children had to use the word in either written or spoken language before it was included in the frequency count. This should have insured that the items selected for presentation in the learning task were well within the functional vocabulary of the second-grade Ss. Any lack of PI build-up across trials at the second-grade level could then be attributed to a failure to use conceptual class as the encoding dimension rather than to a lack of familiarity with the concepts presented.

The majority of words selected for inclusion in the learning task were in the first or second thousand in frequency of occurrence at the second-grade level. One instance in the animal category, three in the body-part category, four in the clothing category, and three in the vegetable category were from the third thousand in frequency. One instance in the vegetable category was in the fourth thousand in frequency. These additional items of higher frequency had to be added to provide 15 words in each conceptual category. This was the minimum number required for the learning task. The words used and their frequency at the second-grade level appear in Appendix B.

In assigning the 15 words to five different triads, each to be presented on a different trial, an attempt was made to equate word length, number of syllables, and mean frequency across triads. The first word in each triad began with a different letter. An attempt was also made to minimize interitem associations such as having "cat" and "dog" appear within the same triad.

Procedure. As each child entered the room, the Experimenter introduced herself to the child and asked him to be seated by a small table containing a Wollensak tape recorder. The entire procedure was recorded. If after hearing the taped instructions (Appendix A) the S had any questions regarding what he was to do, these questions were answered by the Experimenter. In a few instances where it appeared that the child did not understand the instructions but was not going to ask any questions, the Experimenter repeated the instructions in a manner similar to that on the tape. Auditory rather than visual presentation was used to eliminate the problem of deficient reading skills in the second-grade group.

On the first four trials of the STM task, the E group was given word triads, one on each trial, from the same conceptual class. On the shift trial, the E group received a word triad from another conceptual class. The C groups continued on triads from the same conceptual class over all five trials. The appropriate control (C) for each E group was the C group which was given the identical triad on the last trial. The following example illustrates this relationship:

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Experimental					
	Fox	Bear	Lion	Camel	Tongue
	Leopard	Horse	Cat	Wolf	Leg
	Cow	Deer	Beaver	Goat	Hand
Control					
	Finger	Arm	Wrist	Nose	Tongue
	Neck	Chest	Knee	Foot	Leg
	Ear	Lips	Head	Mouth	Hand

Following the recorded instructions, a 2-second tone sounded indicating the immediate presentation of the three words for Trial 1. The three words were presented during a 5-second interval with 5 seconds allowed for the S to repeat the words outloud immediately after their presentation. This permitted the Experimenter to check for accurate auditory perception. The retention interval was 15 seconds in length. During this time the S was shown a large card with 2-inch black numerals arranged in three rows with seven numerals per row. The numerals were taken from the Table of Random Numbers, with the exception that none of the single digit numerals was repeated in adjacent positions. The S began reading in the upper left hand corner and continued through the list at the rate of approximately one numeral every second until a tone sounded. A Taktell metronome was used to pace the numeral reading throughout the retention interval. The tone indicated the beginning of the recall period which was 15 seconds in length. The S reported as many of the words as he could remember to the Experimenter who recorded the S's responses on specially prepared data sheets. This procedure was repeated for five trials. A different card containing 21 numerals was used for the retention interval task after each trial.

The specific tasks presented to the E and C groups appear in Appendix C. Within the Conceptual dimension there were four different E conditions and four different C conditions constituting eight different presentations. The E and C conditions were presented alternately.

As each S arrived for testing, he was assigned to the E or C group. The entire learning task, including instructions, took approximately 10-12 minutes for each S.

Encoding Based on Semantic Differential Dimensions

The primary concern of this experiment was whether children encode words in STM according to their connotative meaning in terms of Evaluation, Potency, and Activity as scaled by the Semantic Differential. DiVesta (1966) in presenting 100 common nouns to children in Grades 2-6 for adjective elicitation, found in analyzing the modifiers that the Evaluation dimension was one of the first attributes of connotative meaning to be employed in natural language.

DiVesta (1966) had children in Grades 2-7 rate a total of 100 concepts on the Semantic Differential. Each child rated 20 concepts on 27 scales. The Evaluation factor appeared with considerable stability at each grade level. A definite developmental change observed in the unrotated factor analysis was the shift from the dominance of the Dynamism factor in the second through the fourth grades to the separation of that factor into Activity and Potency factors between the fifth and seventh grades. It appeared that young children perceive all big things as strong and all strong things as fast without differentiation.

DiVesta concluded that the semantic structures of children are very much like those of adults. Because some of the child's first language experiences refer to qualities of goodness and badness, the

Evaluation system may emerge at pre-school age. Dynamism is the next factor to emerge, co-existing with Evaluation until its further breakdown into Activity and Potency. The final three factor system of the older child and adult consists of Evaluation, Potency, and Activity.

Predictions. If the two extreme ends of the Evaluation dimension represent different classes in STM, a shift to the opposite end of the dimension for the E group after the build-up of PI across preshift trials should result in an improvement in performance. Since the Evaluation dimension appears to emerge early in childhood, both the second- and sixth-grade E groups should exhibit significant release from PI on the shift trial.

In the Activity and Potency dimensions, PI build-up should be minimal for the second-grade Ss and release from PI should not occur in the E group on the shift trial. Two equally plausible reasons for these results could be: 1) the separate factors of Activity and Potency have not emerged from Dynamism at the second-grade level, 2) although the Activity and Potency dimensions have emerged, they are not functioning as encoding categories in STM. The sixth-grade E group should exhibit both the build-up of PI over trials and significant release from PI on the shift trial. According to DiVesta, both Activity and Potency exist as separate dimensions at this grade level. If PI build-up and release does not occur, the sixth-grade Ss are apparently not using these dimensions for encoding the words presented in the learning task.

Method

Design. Within each of the Semantic Differential dimensions, the Ss were divided into 16 groups of 10 each based on two grade levels (second and sixth grade), two treatments (experimental and control), and four orders of presentation with two orders representing a change from the negative to the positive end of the dimension and the other two orders representing a change from the positive to the negative end of the dimension.

Subjects. The 240 second-grade and 240 sixth-grade students who participated in this experiment were obtained from the pool of Ss previously described.

Materials. All words that appeared to be polarized on one dimension and relatively neutral on the other two dimensions according to "Semantic Differential Profiles for 1,000 Most Frequent English Words" by D. R. Heise (1965) were included in a list compiled for each dimension. These profiles were the result of data collected on adult Ss. To check on the degree of similarity between the word ratings of adults and children, the Experimenter consulted the article "Semantic Differential Ratings of 220 Concepts by Grade School Children," prepared by Francis J. DiVesta (1966). All of the words selected from Heise's study could not be given a rating from DiVesta's data because of the limited number of words rated in the latter study. In the Evaluation dimension, 10 out of 18 negative words and 12 out of 18 positive words had received similar ratings by children and adults. In the Potency dimension, children's ratings were available for only 1 of the negative words and 5 of the positive words. These were similar to the adult ratings. Children's ratings were available on only 2 out of 18 negative words and 4 out of 18 positive words in the Activity dimension. These were similar to ratings by adults. The words were also checked for frequency in the Rinsland word count to insure that they were in the functional vocabulary of the second-grade Ss.

If the words met the criteria of being either negatively or positively polarized on one dimension but relatively neutral on the other two dimensions and were in the first five thousand in frequency at the second-grade level, they were used in the learning task. This provided only the minimum number of 18 items for each end of the three dimensions needed for the STM task. The frequency ratings of the items appear in Appendix B.

In assigning each group of 18 words to six different triads, each to be presented on a different trial, an attempt was made to equate word length, number of syllables, and mean frequency across triads. The first word in each triad began with a different letter and all the words within a triad had a different first letter. Interitem associations within triads were kept at a minimum.

Procedure. The instructions and procedure for the STM task using the Semantic Differential dimensions were the same as those used in the Conceptual dimension except that six trials rather than five trials were given. Word triads homogeneous in regard to scaling on the specific connotative dimension were presented on the first five trials. On the sixth trial, the E groups were given instances from the opposite end of the dimension, the change being either from positive to negative or negative to positive. The C groups received words from the same end of the connotative dimension across all six trials. Because the Semantic Differential dimensions have been relatively weak variables in many verbal learning studies, five instead of four trials were used prior to the shift trial to maximize PI build-up. The appropriate C group for each E group was the C group which was given the identical triad on the last trial. The following example from the Potency dimension illustrates this relationship:

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Experimental					
Officer	Machine	Control	Law	Soldier	Child
Strong	Army	Leader	Mountain	Tree	Flower
Rock	Train	Iron	Hard	Power	Sweet
Control					
Voice	Lady	Artist	Daughter	Summer	Child
Sister	Poet	Baby	Sing	Kiss	Flower
Young	Beautiful	Spring	Face	Little	Sweet

Encoding Based on Acoustical Characteristics

Acoustical encoding was considered to be the primary encoding dimension in STM by Conrad (1964) and Wickelgren (1965). Recent research by Wickens and Eckler (1968) and Wickens and Simpson (in press), has suggested that when meaningful items are used, acoustical encoding in STM is minimal. It was the intent of the present experiment to explore developmental changes in the frequency of acoustical encoding of meaningful items in a STM task.

Predictions. It was predicted that the second-grade Ss would exhibit the greatest degree of PI build-up on acoustically similar items and also the greatest degree of release from PI on the shift trial since they would be more likely to encode on acoustical dimensions than would sixth-grade or adult Ss. As the child's vocabulary and associative network increases in complexity, other dimensions more directly related to word meaning should emerge as encoding categories.

The build-up and release from PI should be minimal at the adult level. Sixth-grade Ss should exhibit performance characteristic of a transitional group with an intermediate amount of PI build-up across trials. Some release from PI may be apparent in the sixth-grade E group, but this should be less than is apparent at the second-grade level.

Method

Design. The Ss were divided into 24 groups of 10 Ss each based on three grade levels (second-grade, sixth-grade, and sophomore college students), two treatments (experimental and control), and four different triad orders (two within each group of acoustically similar words). An adult group was added in this experiment since adult Ss had not previously been tested on this dimension using the Wickens, Born, and Allen technique.

Subjects. The 80 second-grade and 80 sixth-grade Ss used in this experiment were drawn from the S pool previously described. The adult

Ss were sophomore college students enrolled in a general education offering within the College of Business at Northern Illinois University, DeKalb, Illinois. The Ss were asked to participate in the study during the regular class periods. Participation was voluntary but only one or two students within each class did not volunteer to participate. The college Ss were tested in a small office-practice area immediately adjacent to the classroom.

Materials. The materials used in this experiment consisted of two groups of 15 words each. In one group, all of the words rhymed with "care". In the second group, all of the words rhymed with "blue". In each group of 15 words, 9 of the words were in the first one thousand in frequency at the second-grade level according to Rinsland's frequency count. The remaining 6 words in each group were in the second, third, or fourth thousand in frequency. The frequency count for the words used in the learning task is presented in Appendix B.

Each group of 15 words was arranged into five triads of three words each. An attempt was made to equate word length, number of syllables, and mean frequency across triads. The first word in each triad began with a different letter and all the words within a triad had a different first letter. Interitem associations within triads were kept at a minimum.

Procedure. The procedure and instructions used in this experiment were the same as those used in the previous two experiments. Five trials were given. Two E groups within each grade level shifted on the fifth trial from words rhyming with "care" to words rhyming with "blue". The other two E groups shifted from words rhyming with "blue" to words rhyming with "care" on the shift trial. The following example illustrates the task given to one of the experimental groups and the task given to its appropriate control group. The STM tasks presented to the E and C groups appear in Appendix C.

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Experimental				
Chew	Few	New	Glue	Care
You	Blue	Screw	Flew	Share
True	Drew	Two	Zoo	Pair
Control				
Spare	Prayer	Tear	Fair	Care
Wear	Bear	Hair	Chair	Share
There	Air	Stare	Dare	Pair

It was especially important within this dimension that the Ss repeat the presented words outloud before the retention interval began to insure accurate auditory perception. The words differed only in their initial sounds and could be more easily confused than the words presented in the previous dimensions. If faulty perception occurred, acoustical encoding and inaccurate auditory perception would be confounded. The data of any S who appeared prone to perceptual errors throughout the learning task were omitted from the study and another S was selected to replace him. Eleven replacements were used at the second-grade level, four at the sixth-grade level, and two at the college level.

Results

Each S received a score on every trial based on the number of words correctly recalled. This score could be either 0, 1, 2, or 3. A score of 3 indicated perfect performance on that trial. A word was scored as correct if it was recalled by the S, regardless of whether the position of recall was the same as the position of presentation within the triad. Intrusions that occurred during recall were coded according to type to permit statistical analysis. Intrusions could be of two types: 1) an intrusion from within the list, the word having been presented on a previous trial, or 2) an intrusion from outside the words presented in the experimental task.

Encoding based on conceptual category. The conceptual dimension is one that is likely to emerge during pre-school or early-school years as a meaningful encoding category. The learning curves over trials for the second- and sixth-grade E and C groups are presented in Figure 1. Each point represents the mean number of correct responses on that trial for the 40 Ss within that group. The conceptual change on the last trial in the E group resulted in an increment in the number of words correctly recalled at both the second- and sixth-grade levels. In the second-grade E group, a frequency count indicated that 75 per cent of the Ss showed an increase in the number of words correctly recalled on Trial 5 while 38 per cent of the Ss in the second-grade C group showed a similar increment. In the sixth-grade E group, 77.5 per cent of the Ss showed an increase in the number of words correctly recalled on the shift trial compared to

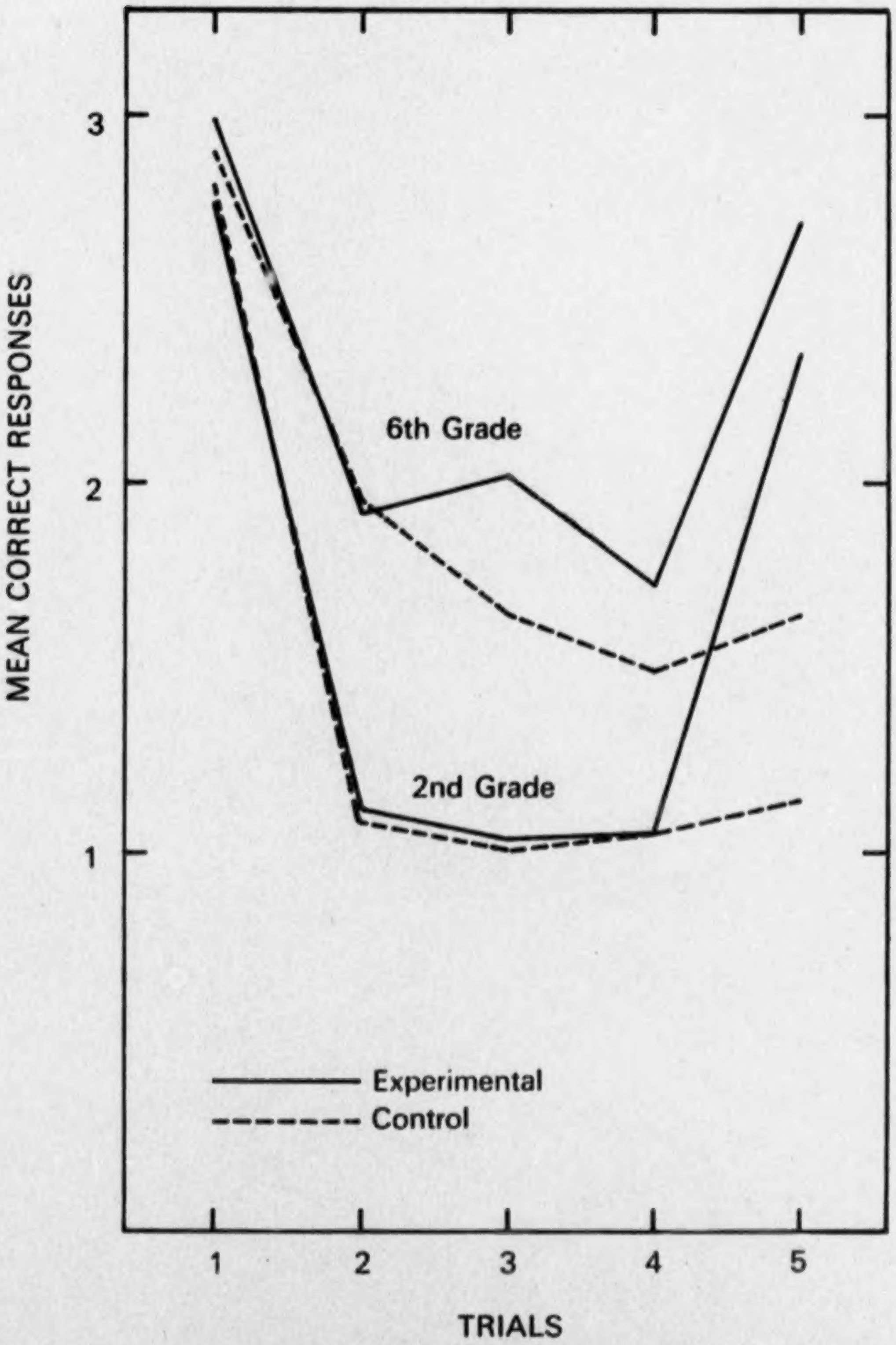

Fig. 1. Learning as a function of trials, and amount of release from PI shown on the shift trial by the experimental groups in the conceptual dimension.

28 per cent of the Ss in the sixth-grade C group. It appeared that a number of Ss at both grade levels were encoding on the Conceptual dimension.

The effects of Grade, Experimental Treatment, and Order of Presentation within the Conceptual dimension were analyzed using analysis of variance. Each S was given a difference score obtained by subtracting the number of words correctly recalled on Trial 4 from the number of words correctly recalled on Trial 5. These scores were used in the analysis of variance as a measure of the degree of change in performance from the pre-shift to the shift trial. The summary table for this analysis is presented in Table 1.

TABLE 1

ANALYSIS OF RELEASE FROM PROACTIVE INHIBITION IN THE CONCEPTUAL DIMENSION BASED ON TRIAL 5 MINUS TRIAL 4 DIFFERENCE SCORES

Source	df	MS	F
Grade (G)	1	.51	.47
Experimental (E)	1	41.01	38.02 **
Order (O)	3	.27	.25
GxE	1	1.41	1.30
GxO	3	4.86	4.50 **
ExO	3	.56	.52
GxExO	3	.82	.76
Within Cells	144	1.08	--

*p. $<$.05

**p. $<$ .01

The effect of Grade was not significant since the second-grade Ss had a mean difference score of .675 while the sixth-grade Ss had a mean difference score of .563 resulting in an F value of .47. The effect of the Experimental Treatment was significant. The mean difference scores for the combined second- and sixth-grade E and C groups were 1.13 and .11 respectively. Release from PI had occurred at both grade levels. Order did not result in a reliable difference between groups. The Grade x Experimental Treatment interaction failed to reach significance indicating that the amount of release from PI in the second- and sixth-grade E groups did not differ significantly.

A Grade x Order interaction resulted from the marked difference in the mean scores of the second- and sixth-grade Ss within Order 4. A Duncan Multiple Range Test on the individual means indicated that in Orders 1, 2, and 3, the difference scores for the second- and sixth-grade Ss were not reliably different. In Order 4 the mean difference scores for the second- and sixth-grade groups were .250 and 1.10 respectively. This difference was significant. When the E and C groups at each grade level within Order 4 were compared, the means for the second- and sixth-grade E groups were not significantly different being .900 and 1.300 respectively. The means of the second- and sixth-grade C groups were significantly different being -.400 and .900 respectively. Since the locus of the difference in Order 4 was between the second- and sixth-grade C groups rather than the E groups, the interaction of Grade x Order within the Conceptual dimension was considered empirically and theoretically irrelevant.

The Experimental Treatment did not interact significantly with Order. The Grade x Experimental Treatment x Order interaction also was not significant.

Encoding based on semantic differential categories. Within the semantic differential dimensions it was predicted that Evaluation would be the first encoding dimension to emerge followed at a later time in cognitive development by Activity and Potency. Performance on each dimension was examined separately.

The learning curves over trials for the second- and sixth-grade Ss in the Evaluation dimension are presented in Figure 2. Each point represents the mean number of correct responses on that trial for the 40 Ss within that group. The change from the positive to the negative end of the dimension or vice versa in the E groups on the shift trial resulted in an increment in the number of words correctly recalled at both the second- and sixth-grade levels.

When the per cent of Ss in the second-grade E group which showed an increase in the number of words correctly recalled on Trial 6 was compared with the per cent in the C group that showed an increment, these values were 60 per cent and 33 per cent respectively. In the sixth-grade, the percentages for the E and C groups were 63 per cent and 30 per cent respectively. It appeared that in both the second- and sixth-grade groups some Ss were coding on the Evaluation dimension.

The effect of Grade, Experimental Treatment, and Order of Presentation within the Evaluation dimension were analyzed using analysis

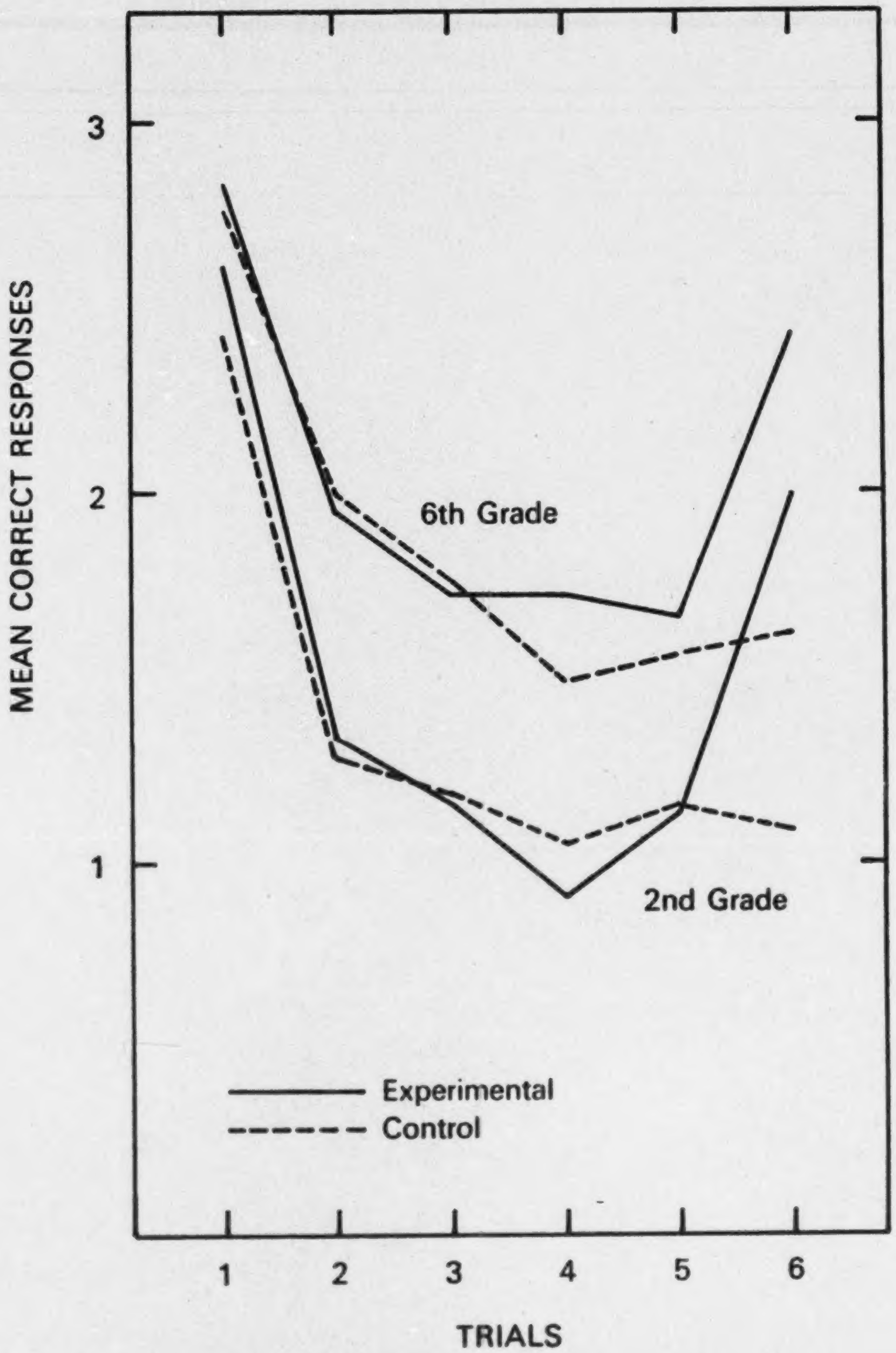

Fig. 2. Learning as a function of trials, and amount of release from PI shown on the shift trial by the experimental groups in the evaluation dimension.

of variance. Each S was given a difference score obtained by subtracting the number of words correctly recalled on Trial 5 from the number of words correctly recalled on Trial 6. These scores were considered to be a measure of the degree of change in recall performance from the pre-shift to the shift trial. The summary table for this analysis is presented in Table 2.

TABLE 2

ANALYSIS OF VARIANCE FOR THE EVALUATION DIMENSION OF THE SEMANTIC DIFFERENTIAL

Source	df	MS	F
Grade (G)	1	.01	.01
Experimental (E)	1	26.41	22.67 **
Order (O)	3	.17	.15
GxE	1	.51	.44
GxO	3	3.11	2.67 *
ExO	3	2.14	1.84
GxExO	3	1.11	.95
Within Cells	144	1.17	--

$*p. < .05$

$**p. < .01$

The effect of Grade was not significant resulting in an F score of only .01. The Experimental Treatment resulted in a reliable difference between groups with the means for the E and C groups being .800

and -.013 respectively. The shift trial resulted in an improvement in recall performance for the E Ss. The Grade x Experimental Treatment interaction failed to reach significance indicating that the degree of release from PI in the second- and sixth-grade E groups was not reliably different.

The effect of Order was not significant. However, Grade interacted with Order just reaching significance at the .05 level with an F of 2.67. The Duncan Multiple Range Test did not yield any reliable differences between the individual means. It appeared that the interaction was due to the mean difference scores for the second- and sixth-grade Ss within Orders 2 and 4. In Order 2, the mean for the second grade was .100 and for the sixth grade .800. In Order 4, the direction of the difference was reversed with the second grade exhibiting a mean of .750 and the sixth grade a mean of .100. Since the interaction was of borderline significance, just reaching the .05 level, and since in both Order 2 and 4 the Ss were shifted from the positive to the negative end of the Evaluation scale, this interaction did not appear to be of empirical or theoretical importance. The Experimental Treatment x Order interaction and the Grade x Experimental Treatment x Order interaction were not significant.

The data from the Potency dimension resulted in the learning curves for the second- and sixth-grade E and C groups presented in Figure 3. The change from the positive to the negative end of the Potency dimension or vice versa did not appear to have an effect on the performance of the E groups at either grade level. Twenty-eight

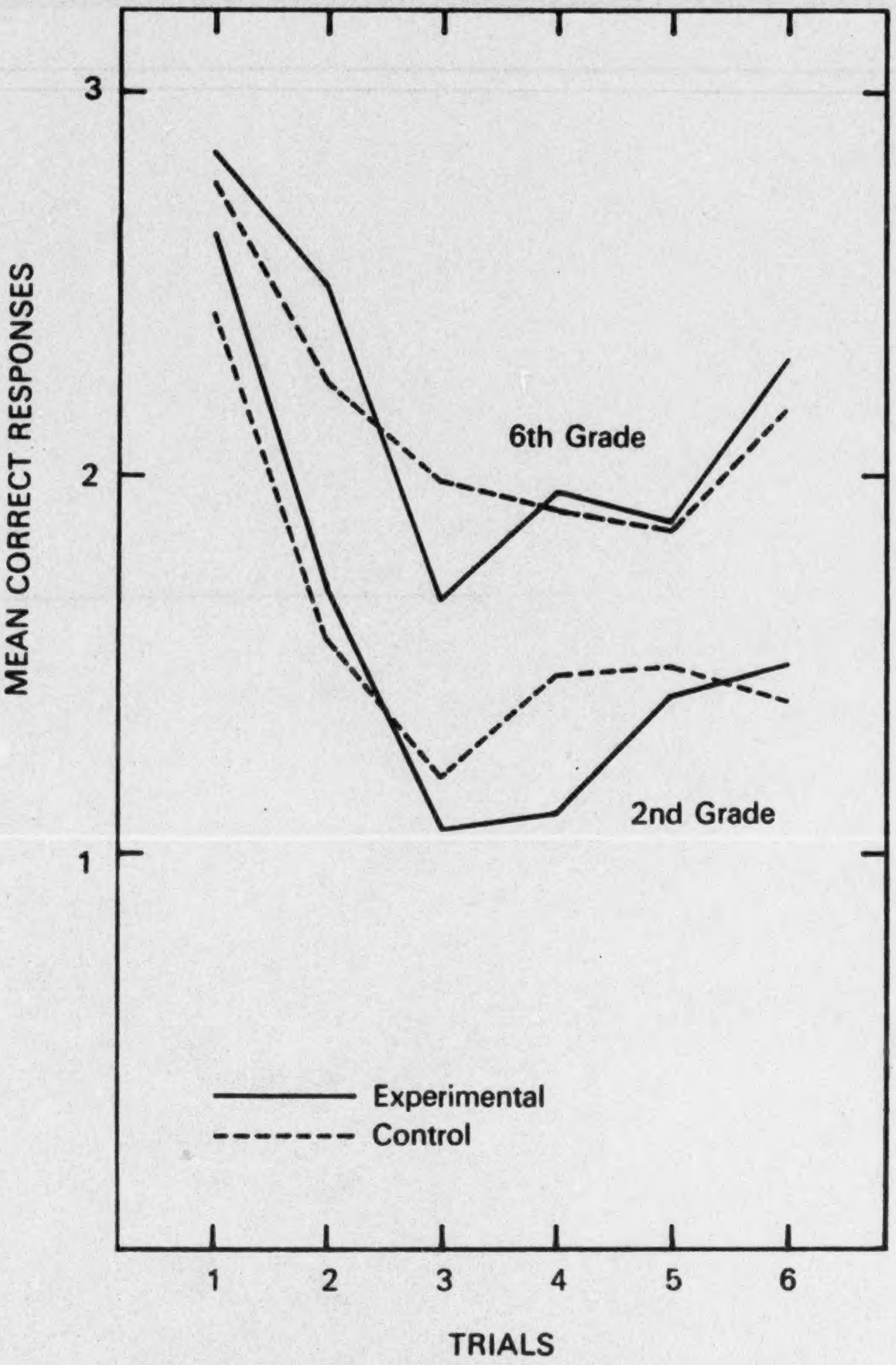

Fig. 3. Learning as a function of trials, and absence of release from PI shown on the shift trial by the experimental groups in the potency dimension.

per cent of the second-grade E Ss showed an increment in the number of words correctly recalled on the shift trial. Thirty per cent of the C Ss showed a similar increment in performance. At the sixth-grade level, 52 per cent of the E Ss showed an increment compared to 35 per cent of the C Ss. It is possible that some Ss in the sixth grade were coding on the Potency dimension but this number was not sufficient to produce an overall effect of the Experimental Treatment or a Grade x Experimental Treatment interaction.

The effect of Grade, Experimental Treatment, and Order of Presentation within the Potency dimension were analyzed using analysis of variance. Each S was given a difference score based on the number of words correctly recalled on Trial 6 minus the number of words correctly recalled on Trial 5. These scores were used in the analysis. The summary table of the results is presented in Table 3.

TABLE 3

ANALYSIS OF VARIANCE FOR THE POTENCY DIMENSION OF THE SEMANTIC DIFFERENTIAL

Source	df	MS	F
Grade (G)	1	6.40	4.35 *
Experimental (E)	1	.90	.61
Order (O)	3	1.14	.78
GxE	1	.02	.01
GxO	3	2.92	1.99
ExO	3	1.52	1.03
GxExO	3	2.31	1.57
Within Cells	144	1.47	--

$^{*}p. < .05$
$^{**}p. < .01$

The Experimental Treatment did not produce a reliable difference between the E and C groups within the Potency dimension as an F score of only .61 was obtained. Release from PI was not apparent at either the second- or sixth-grade level. Grade reached significance at the .05 level with the second grade having a mean difference score of -.013 and the sixth grade a mean difference score of .413. This difference appeared to be the result of the slight increment on the shift trial exhibited by both the sixth-grade E and C groups. This increment was not apparent at the second-grade level. Order of Presentation did not result in a reliable difference between groups. The Grade x Experimental Treatment, Grade x Order, Experimental Treatment x Order and Grade x Experimental Treatment x Order interactions also failed to reach significance.

It appeared that the Potency dimension had not yet emerged as a functional encoding category at the second-grade level. At the sixth-grade level, according to Semantic Differential ratings the dimension has emerged. However, few sixth-grade Ss appeared to be using Potency as an encoding category for the words presented in the STM task.

The data from the Activity dimension resulted in the learning curves for the second- and sixth-grade E and C groups presented in Figure 4. The change from the positive to the negative end of the Activity dimension or vice versa did not appear to have a significant effect on the performance of the E group at either grade level. The per cent of second-grade E Ss who showed an increment in performance fron Trial 5 to Trial 6 was 42.5 per cent compared to 45 per cent of

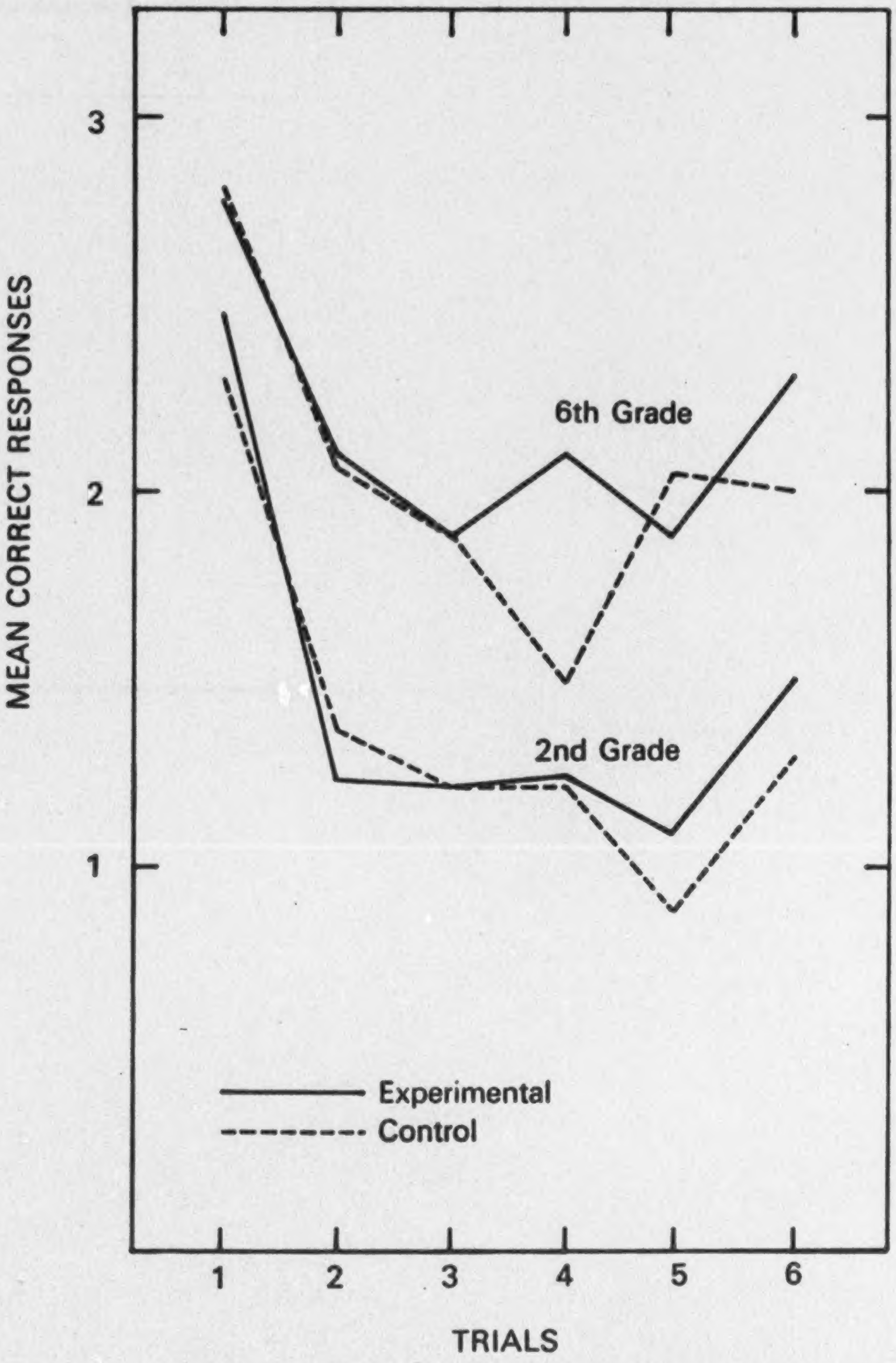

Fig. 4. Learning as a function of trials, and absence of release from PI shown on the shift trial by the experimental groups in the activity dimension.

the C Ss showing a similar increment. In the sixth-grade group, 40 per cent of the E Ss showed an increment in number of words correct from Trial 5 to Trial 6 compared to 28 per cent of the Ss in the C group.

In analyzing the Activity dimension data, the number of words correctly recalled on Trial 6 minus the number of words correctly recalled on Trial 5 difference scores were again used. The summary table for this analysis is presented in Table 4.

TABLE 4

ANALYSIS OF VARIANCE FOR THE ACTIVITY DIMENSION OF THE SEMANTIC DIFFERENTIAL

Source	df	MS	F
Grade (G)	1	.90	.72
Experimental (E)	1	2.02	1.62
Order (O)	3	1.24	.99
GxE	1	2.50	2.00
GxO	3	.75	.60
ExO	3	3.18	2.54
GxExO	3	.42	.34
Within Cells	144	1.25	--

*p. $< .05$
**p. $< .01$

Grade was not a significant variable with the mean difference score for the second-grade being .388 and that for the sixth-grade

.238. The Experimental Treatment failed to produce a reliable difference between the E and C groups. The mean difference score for the E group was .425 compared to a mean difference score of .200 for the C group. The absence of a Grade x Experimental Treatment interaction indicated that release from PI had not occurred within the Activity dimension at either grade level. Order of Presentation did not produce a reliable difference between groups. None of the first order interactions were significant. The Grade x Experimental Treatment x Order interaction also failed to reach significance.

It appeared that neither the second- nor the sixth-grade S̲s were encoding on the Activity dimension. At the second-grade level this may have been due to the fact that this dimension had not yet emerged as a functional connotative dimension. At the sixth-grade level, although the dimension is apparent in Semantic Differential scaling, few S̲s appeared to be encoding on this dimension in the STM task.

Encoding based on acoustical characteristics. In this experiment S̲s were given words which rhymed with one another, differing only in the initial sounds. The primary purpose in manipulating this dimension was to determine if acoustical encoding decreased with age. It is possible that as dimensions of meaning become more prominent as encoding categories, acoustical characteristics of words decrease in importance. Adult S̲s were included in this experiment.

The data from the Rhyme dimension resulted in the learning curves for the second-, sixth-grade, and adult E and C groups presented in Figure 5. The change from words with one acoustical sound to words

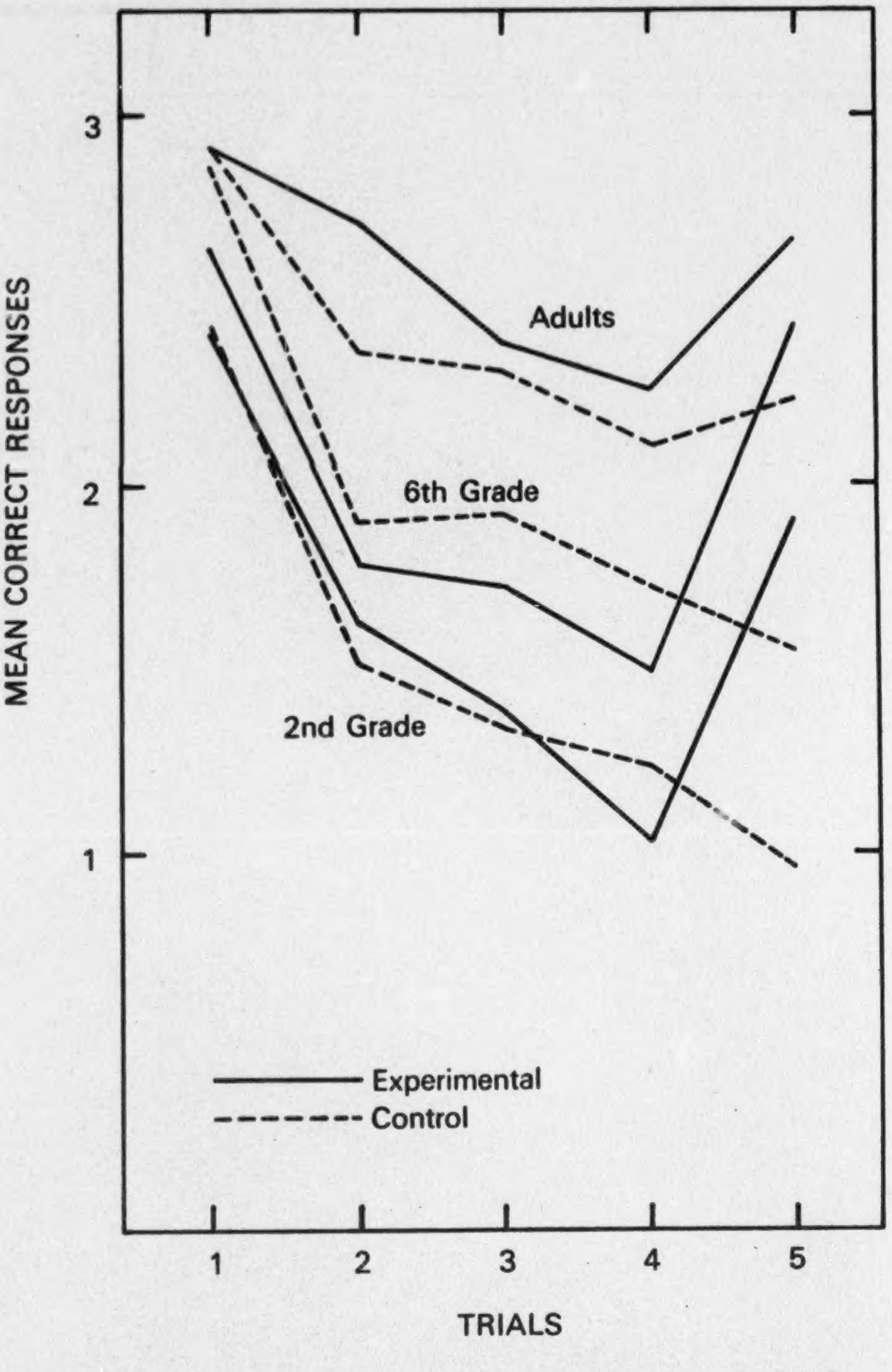

Fig. 5. Learning as a function of trials, and amount of release from PI shown on the shift trial by the experimental groups in the rhyme dimension.

that had a different acoustical sound appeared to have a definite effect on the performance of the E groups in the second and sixth grades. Sixty-five per cent of second-grade Ss showed an increment in the number of words correctly recalled on the shift trial compared to 25 per cent in the C group who showed a similar increment. At the sixth-grade level, 65 per cent of the E Ss showed an increment on the shift trial while only 30 per cent of the Ss in the C group showed an increment on Trial 5. In the adult group, only 35 per cent of the E Ss showed an increase in the number correct on Trial 5 while 33 per cent of the C Ss showed a similar increase. Both in the amount of PI built up over trials and in the increment from the pre-shift to the shift trial, it appeared that second- and sixth-grade Ss were encoding on the Rhyme or Acoustical dimension but adults were not.

In the Rhyme dimension, the number of words correctly recalled on Trial 4 was subtracted from the number of words correctly recalled on Trial 5 to obtain a difference score for each S. The summary table for the analysis of variance in which these scores were used appears in Table 5.

The effect of Grade was not significant, the difference scores for the second-grade, sixth-grade, and adults being .288, .375, and .265 respectively. The only significant main effect was that of the Experimental Treatment. The mean difference score for the E group was .725 and for the C group it was -.163. Grade interacted with Experimental Treatment as the mean difference scores for the E and C groups within the second and sixth grades were significantly different

TABLE 5

ANALYSIS OF VARIANCE FOR THE RHYME DIMENSION

Source	df	MS	F
Grade (G)	2	.28	.23
Experimental (E)	1	41.67	33.66 **
Order (O)	3	1.36	1.10
GxE	2	4.68	3.78 *
GxO	6	4.31	3.48 **
ExO	3	2.41	1.95
GxExO	6	.84	.68
Within Cells	216	1.24	--

*p. $< .05$

**p. $< .01$

but the E and C group means were not reliably different in the adult group. The mean difference scores for the second-grade E and C groups were .850 and -.275 respectively. The mean for the sixth-grade E group was .925 and for the C group -.175. The mean difference scores for the adult E and C groups were .400 and .125 respectively. This interaction appeared to indicate that acoustical encoding decreased with increasing chronological age.

Grade interacted significantly with Order. A Duncan Multiple Range Test revealed that second-grade, sixth-grade, and adult *S*s did not differ significantly in their mean difference scores in Orders 1, 2, and 3. In Order 4, the mean difference score for the adult group was -.350. This was significantly different from the mean difference scores for the second- and sixth-grade Ss which were .600 and .750 respectively and did not differ significantly from each other. The reason for this Order effect was not apparent from perusal of the Order 4 learning task presented to the Ss.

Analysis of performance decrement over trials. An analysis of the amount of decrement in recall performance from Trial 1 to Trial 4 was carried out to determine if the amount of PI build-up over trials differed for second- and sixth-grade Ss. It is possible that greater PI build-up at one level would permit greater release to occur on the shift trial. A difference score was obtained for each S by subtracting the number of words correctly recalled on Trial 4 from the number of words correctly recalled on Trial 1. These scores were used in the analysis. The E and C groups were pooled since the degree of PI build-up should not differ for the two groups. A two-way analysis of variance was performed using Grade and dimension as the variables. The summary table for this analysis is presented in Table 6.

The mean difference scores for second- and sixth-grade Ss were 1.372 and 1.092 respectively. In the analysis of variance this difference was significant indicating a greater degree of PI build-up at the second-grade than at the sixth-grade level. Dimension was also a significant variable with the highest mean difference scores occurring in the Conceptual and Evaluation dimensions, the means being 1.507 and 1.344 respectively. In the Rhyme dimension, the

TABLE 6

ANALYSIS OF PERFORMANCE DECREMENT OVER TRIALS 1 TO 4

Source	df	MS	F
Grade (G)	1	15.68	14.76 **
Dimension (D)	4	5.95	5.60 **
GxD	4	.49	.46
Within Cells	790	1.06	--

*p. $<$.05

**p. $<$.01

mean difference score was 1.194. The lowest mean difference scores occurred in the Activity and Potency dimensions where the means were 1.056 and 1.062 respectively. Although a Duncan Multiple Range test indicated that the Conceptual and Evaluation means just failed to be significantly different from the Activity and Potency means, these data do appear to support the release from PI data since greater PI build-up occurred in those dimensions where release from PI occurred. The Grade x Dimension interaction was not significant, indicating that PI build-up was consistently greater in the second-grade group than in the sixth-grade group across all dimensions.

Intrusions from within the presented list. Since PI build-up was greatest in those dimensions where release from PI was obtained, it was apparent that the total number of errors within these dimensions was larger than in the dimensions where release from PI did not occur. It was believed that examination of the intrusions from within the presented list might add further support to the release from PI findings. If a S was encoding on the dimension being manipulated, the category name such as "animal" or the connotative label such as "good" might occur as an implicit associative response (IAR). When this IAR occurred to an item, it might through backward association make a previously presented item available and this would result in an intrusion from within the list upon recall.

The mean number of within-list intrusions as a function of dimension and trial is presented in Figure 6. In this figure, the second- and sixth-grade groups were combined since both showed release from PI on the same dimensions. Only Trials 2, 3, and 4 were used since within-list intrusions could not occur on Trial 1, and Trial 5 represented a shift trial in the Concept and Rhyme dimension.

It is apparent that the mean number of within-list intrusions was greatest in those dimensions where release from PI occurred. To determine if this reflected only the large number of total errors within these dimensions or if within-list intrusions constituted a greater proportion of the total errors in these dimensions than in those where release from PI did not occur, appropriate proportions were computed. Within-list intrusions accounted for .28 of the total errors in the Concept dimension, .19 of the total errors in the Evaluation dimension, .12 of the total errors in the Potency dimension, .15 of the total errors in the Activity dimension, and .44 of the total errors in the Rhyme dimension. The pattern of the proportions

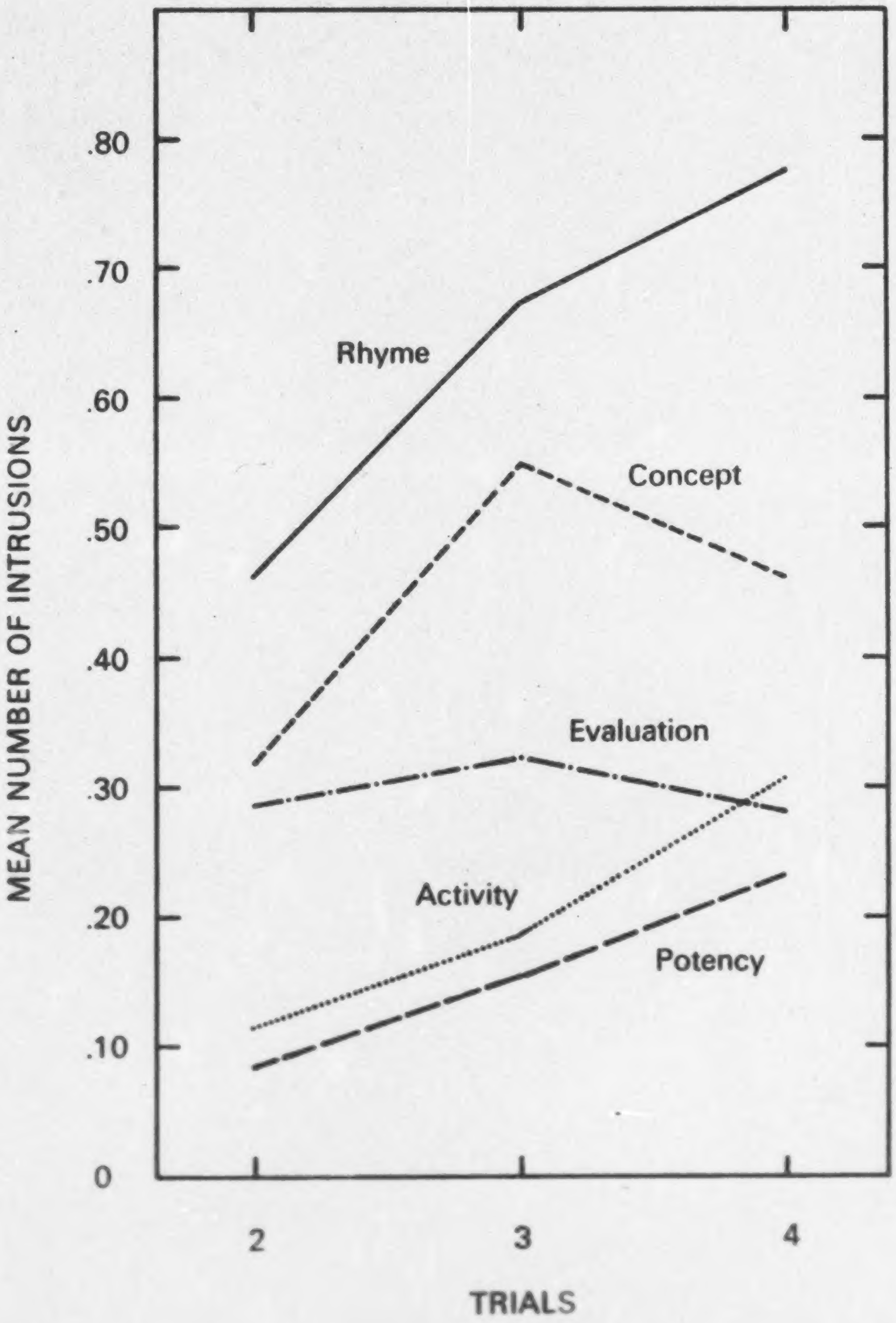

Fig. 6. Mean number of intrusions from within the presented learning list as a function of dimension and trial with second and sixth grades combined.

paralleled that of the means with the proportion of within-list intrusions being higher in the dimensions where release from PI was obtained. The proportion of within-list intrusions in the Rhyme dimension was undoubtedly inflated since if the S̲ recognized that the words in the learning task rhymed, his probability of selecting a word from the list was very high as the list was quite exhaustive. As a reciprocal effect, the number of omission errors in the Rhyme dimension was very low.

The proportion of total errors represented by within-list intrusions was highly similar for the second- and sixth-grade groups in the Concept, Evaluation, and Potency dimensions. This was consistent with predictions as the degree of release from PI did not differ between the second- and sixth-grade groups within these dimensions. However, the proportion of within-list intrusions at the second- and sixth-grade levels in the Activity and Rhyme dimensions failed to support predictions based on IAR production. In the Activity dimension, at the second grade level .11 of the total errors were within-list intrusions while at the sixth-grade level .21 of the total errors were within-list intrusions. To parallel release from PI findings these proportions should have been highly similar and low. In the Rhyme dimension, the difference was in the opposite direction with .48 of the total errors at the second-grade level representing within-list intrusions and .40 of the total errors at the sixth-grade level representing within-list intrusions. According to predictions, this difference would indicate a greater degree of encoding on the

Rhyme dimension at the second- than at the sixth-grade level. The amount of release from PI shown by the second- and sixth-grade Ss was approximately equivalent in the Rhyme dimension.

The within-list intrusion data appeared to parallel release from PI findings to some extent. The exceptions occurred in the grade differences within the Activity and Rhyme dimensions.

The source of the within-list intrustions which occurred on Trial 4 when all dimensions were combined was examined to determine if recency and primacy effects were apparent. The source of within-list intrusions on Trial 4, for each grade level is presented in Figure 7. An intrusion could be from Trials 1, 2, or 3. Both primacy and recency effects were apparent at the second-grade level. The sixth-grade Ss exhibited only a recency effect with no apparent primacy effect. The source and number of within-list intrusions on Trial 4 for each dimension and each grade are presented in Table 7. The source of within-list intrusions in the Concept, Potency, and Rhyme dimensions paralleled the overall trend in the combined dimensions. In the adult Rhyme group only a recency effect was apparent.

In the Evaluation dimension, primacy and recency effects existed at the second-grade level but a marked primacy rather than a recency effect was apparent at the sixth-grade level. In the Activity dimension, only a recency effect was apparent in both the second- and sixth-grade groups.

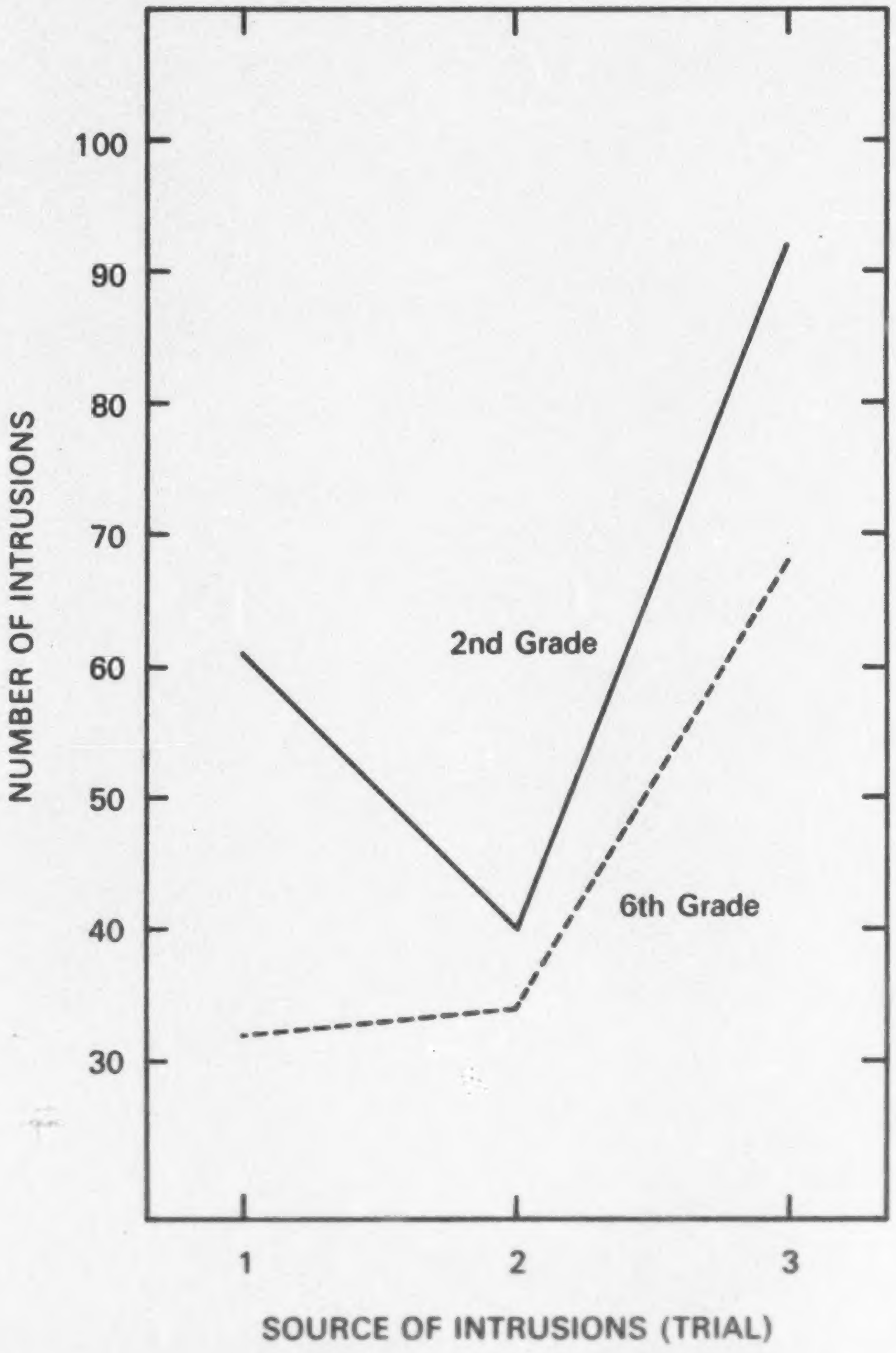

Fig. 7. Number and source of within-list intrusions on Trial 4 for all dimensions at each grade level.

TABLE 7

SOURCE AND NUMBER OF WITHIN-LIST INTRUSIONS ON TRIAL 4 AS DETERMINED BY TRIAL ON WHICH INTRUSION WAS ORIGINALLY PRESENTED AS A TO-BE-REMEMBERED ITEM

Dimension	Grade	Trial on Which Item Occurred as a To-be-remembered Item		
		1	2	3
Concept	Second	15	8	20
	Sixth	5	7	18
Evaluation	Second	8	4	9
	Sixth	12	5	7
Activity	Second	5	4	17
	Sixth	1	7	16
Potency	Second	10	5	10
	Sixth	1	3	6
Rhyme	Second	23	19	36
	Sixth	13	12	21
	Adult	10	14	17

Discussion

The research presented in this paper was an initial attempt to examine developmental changes in encoding processes. Specifically, the research investigated the extent to which children of various ages utilized five selected denotative and connotative dimensions as functional encoding categories in a STM task. The dimensions explored were Conceptual class, the Semantic Differential dimensions of Evaluation, Potency, and Activity, and Acoustical similarity (rhyming words).

It was hypothesized that if the Ss were encoding the words presented on each trial into the same psychological category, a decrement in the number of words correctly recalled should be apparent across trials. This decrement (proactive inhibition) was assumed to be the result of inter-item interference produced by similarly encoding a number of words within a short period of time. A change in the denotation or connotation of the words presented on the last trial of the STM task should result in an increment in the number of words correctly recalled on this trial if the words are coded into a different psychological category since inter-item interference should be minimized. This increment in recall on the trial where a shift in denotation or connotation occurs is referred to as release from proactive inhibition.

If second- and sixth-grade Ss encode in differing frequencies on any of the dimensions being investigated, an examination of the amount of release from PI on the shift trial should reveal a Grade x Experimental Treatment interaction within those dimensions. The amount of release from PI on the shift trial should also give an indication of the prominence of each dimension as a functional encoding category at each grade level.

Release from Proactive Inhibition

Within the dimension of Conceptual class, a significant amount of release from PI was apparent for the E groups in both the second and sixth grades. The amount of release from PI was approximately equivalent for the two grades. This finding did not support the prediction that conceptual encoding would occur more frequently at the sixth-grade than at the second-grade level. This prediction was based on word association norms which indicate that a higher number of conceptual responses occur to single items in the fifth grade than in the first and third grades. It is possible that the presentation of a large number of instances from the same conceptual class as occurred within the present study primed or encouraged conceptual responses which would not have occurred had only a single item been presented as in word association norms.

When the data from the Semantic differential dimensions of Evaluation, Potency, and Activity were considered, significant and approximately equivalent amounts of release from PI occurred in the Evaluation dimension for the second- and sixth-grade Ss. Release from PI was not apparent at either grade level in the Potency and Activity dimensions.

The data in the Evaluation dimension further validated the existence of that connotative dimension as identified by the Semantic

Differential and added support to DiVesta's (1965) findings that the Evaluation dimension appeared to be well-developed by pre-school or early school age. There was no empirical reason to suspect that the degree of encoding on the Evaluation dimension within the STM task would differ for the second- and sixth-grade Ss. The data within the Potency and Activity dimensions supported the prediction that second-grade Ss would not exhibit release from PI. DiVesta has shown in word scaling experiments that the dimension of Dynamism has not yet divided into Potency and Activity at the second-grade level. Based on the findings of DiVesta that the Dynamism factor separated into Potency and Activity between Grades 5 and 7, it was predicted that sixth-grade Ss would show some release from PI when shifted from the negative to the positive end of these dimensions or vice versa. This prediction was not supported in the present study.

A definite limitation was imposed on the interpretation of the Semantic Differential data by the fact that a large number of the words used in the Evaluation dimension task had been scaled by children while in the Potency and Activity dimensions few words used in the tasks had been rated by children. In the Evaluation dimension, the polarization of the words used was directly assessed from the children's norms while polarization of the words used in the Activity and Potency dimensions was based on adult data and the words were only assumed to be similarly scaled by children. It is possible that the Activity and Potency dimensions exist at the second and sixth grade but the words used in the STM tasks did not accurately reflect the structure of the dimensions at these age levels. Thus one is left with two alternative interpretations of the lack of release from PI in the Activity and Potency dimensions; either the dimensions do not exist as prominent encoding categories in the second and sixth grade or the words used in the STM task would not be similarly scaled by children and adults.

Acoustical similarity was the last of the five dimensions to be investigated. When words with a different acoustical sound were presented to the E group on the shift trial, significant and approximately equivalent degrees of PI release were apparent at the second and sixth grades. The adult group exhibited much less PI build-up than did the second- and sixth-grade groups and also experienced little release from PI on the shift trial. The amount of acoustical encoding appeared to decrease with increasing chronological age. This supports the hypothesis that acoustical encoding represents a more primitive form of encoding than does semantic encoding based on connotative or denotative dimensions.

Additional support for encoding on the Conceptual, Evaluation, and Rhyme dimensions was obtained from analysis of the degree of PI build-up across pre-shift trials. A greater degree of PI build-up occurred within these dimensions than within the dimensions of Potency and Activity where no release from PI was apparent. Greater inter-item interference should theoretically exist within the dimensions in which release from PI was apparent since encoding a number of words into the same category should produce a greater decrement across trials than encoding words into different categories. That PI build-up is not entirely dependent on the class of materials used in the STM task is apparent from the build-up of PI in the Potency and Activity dimensions. Since the Ss did not seem to be encoding on these connotative dimensions it is difficult to imagine what other factor common to all of the words in the task might have been used for encoding purposes. It is possible that encoding a number of words into differing psychological categories within a very short temporal period may in itself produce inter-item interference and a subsequent decrement in recall across trials in a STM task.

Limitations of the Release from PI Technique in Developmental Research

When the present study was completed and the data analyzed, a number of limitations were apparent in using the Wickens, Born, and Allen technique to investigate developmental changes in encoding behavior. The most apparent limitation was the differential build-up of PI at the second- and sixth-grade levels. An analysis of the decrement in recall across Trials 1 to 4 revealed that second-grade Ss experienced a greater decrement across trials in all dimensions than did the sixth-grade Ss. That this was not due to a greater degree of encoding on the specific dimension being investigated was evident from the differential build-up of PI at the two grade levels within the Potency and Activity dimensions where no release from PI occurred to indicate encoding on these dimensions.

Three possible mechanisms may account for the greater degree of PI build-up in the second-grade than in the sixth-grade group. It is possible that sixth-grade Ss are better able to differentiate between temporal periods of presentation than are second-grade Ss. Items recently presented may be more distinct from items presented on previous trials for the sixth-grade Ss. This hypothesis is empirically supported by the within-list intrusion serial position curves which indicated that a considerable number of within-list intrusions in the second-grade were from the very first triad presented. In the sixth-grade, the within-list intrusions seldom were from a triad other than the one immediately prior to the trial on which the intrusions occurred.

A second possible explanation is related to the numeral reading task presented during the retention interval. This task may have allowed differing degrees of covert rehearsal at the second- and sixth-grade levels. Numeral reading was chosen as the retention task because it could be performed with ease by the second-grade Ss. A task such as counting backwards by threes would have been too difficult for the second-grade group. It was apparent to the Experimenter that numeral reading was carried out successfully by the sixth-grade Ss with a minimum of effort and concentration. It is very possible that sixth-grade Ss used the retention interval for covert rehearsal while at the same time accurately executing the retention interval task. This could have accounted for the difference in PI build-up at the two grade levels.

It is also possible that the sixth-grade Ss coded the presented words into several categories in addition to the one being experimentally manipulated while the second-grade Ss were coding primarily on the dimension being investigated within the STM task. Multi-dimensional as opposed to unidimensional encoding should result in less concentrated PI build-up within the manipulated dimension and should also provide additional cues that would aid recall on each trial. Multidimensional encoding should minimize inter-item interference and in that way facilitate recall.

Since differential PI build-up at the second- and sixth-grade levels allowed different degrees of release from PI on the shift trial, empirical conclusions could not be drawn about the extent of encoding on each dimension at the two grade levels. For instance, a second-grade S̲ who was coding on the conceptual dimension might exhibit a recall score of zero on the pre-shift trial. If he coded the items on the shift trial into a different conceptual category, an increment in recall of three items was possible. Since recall at the sixth-grade level was higher than at the second-grade level, a sixth-grade S̲ might recall two items on the pre-shift trial. Encoding the items on the shift trial into a different conceptual category could only result in an increment of one item since only three items were presented on each trial. It is possible that the number of S̲s encoding on a specific dimension could be the same at both grade levels, yet the group which had experienced a larger decrement would exhibit a larger increment giving a distorted picture of the actual encoding behavior at the two grade levels.

Recommended Modifications in the Technique for Developmental Research

To make the Wickens, Born, and Allen technique of maximum utility in developmental studies, a number of modifications are necessary. Equating the degree of PI build-up across pre-shift trials at each of the grade levels being tested is of primary importance. This can be done in a number of different ways. The performance levels might be equated by requiring the younger Ss to repeat the word triad presented on each trial two or three times before the retention interval began. The older Ss would repeat the triad only once to allow the Experimenter to check for accurate auditory perception before the start of the retention interval. Pilot work would need to be done to determine how many overt repetitions of the word triad by the younger Ss would equate their performance with that of the older Ss.

The performance of Ss on the pre-shift trials at different age levels might also be equated by varying the difficulty of the retention interval task. The younger group could be given the numeral reading task while the older group was given a task that consisted of counting backwards by twos or threes. If differential rehearsal is the cause of the differing decrements at various age levels, varying the retention interval task might eliminate this difficulty.

It is also suggested that the frequency of the words presented be equated for the grade levels participating in the study. This might also decrease the difference in PI build-up over trials. In the present study, word selection was based only on the frequency of occurrence at the second-grade level. While some of the words selected were in the fourth and fifth thousand in frequency for the second-grade Ss, all of the words were undoubtedly in the first one thousand in frequency at the sixth-grade level. Words should have been selected for each group so that mean frequency was the same at both grade levels. In the conceptual dimension, different concepts could have been used at each grade level to equate PI build-up. Concepts of greater difficulty at the sixth-grade level would most likely have resulted in a greater decrement across pre-shift trials than was apparent in the conceptual dimension within this study.

In future studies of developmental changes in the use of Conceptual class and Evaluation as functional encoding categories, it is recommended that pre-school, kindergarten, and first-grade Ss be used. This might allow identification of the emergence of each of these dimensions as an encoding mechanism. Second-grade Ss were well aware of the differences in conceptual class and also appeared to be encoding on the Evaluation dimension, therefore the use of younger Ss would undoubtedly provide more useful developmental information. To further explore the use of Potency and Activity as encoding dimensions, sixth, seventh, and eighth grades should be used as this is the interval during which these dimensions are likely to become functional as encoding categories in STM.

Concluding Comments

When the results of this study are compared with the results of studies conducted by Wickens and his associates using adults as subjects, it is apparent that encoding processes change with increasing chronological age. Acoustical characteristics of meaningful material appear to serve an important role in encoding at the second- and sixth-grade level but decrease in importance as the individual approaches adulthood. Little acoustical encoding was apparent at the adult level in this study and Wickens has shown that semantic factors override acoustical factors when adults are given words which are acoustically similar but semantically different. Acoustical encoding may be a primitive mode of psychological organization which is largely replaced during development by semantic dimensions.

Denotative and connotative dimensions assume increasing importance in encoding in STM as the child matures. The denotative dimension of Conceptual class appears to emerge as a primary encoding category during early school years and retains its importance throughout adult life. It appears to be of greater importance in encoding processes than the Semantic Differential dimensions of Evaluation, Potency, and Activity. However, the Evaluation dimension appears to function as an encoding category in pre-school or early school years while the dimensions of Activity and Potency apparently do not emerge as functional encoding categories until the fifth to the seventh grade. Both Activity and Potency appear to function as meaningful encoding categories for adults.

It appears that the complexity of the encoding mechanism increases as the individual moves from childhood to adulthood. These developmental changes may in part be responsible for the modifications apparent in conceptual and mediational behavior.

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APPENDIX A

INSTRUCTIONS

Instructions Given to Each Subject Before Beginning the Short-term Memory Task

The following instructions were given to each subject within the experimental and control groups at each grade level. The only exception was that the sentence "We will be playing a word game today." was deleted from the instructions when they were given to adult subjects.

"We will be playing a word game today. When you hear the first bell, three words will follow it. Say the three words outloud exactly as you hear them. Then read the numbers outloud as I point to them until you hear a second bell.* At this bell tell me the three words exactly as you remember them. Then get ready for the next group of words. Are there any questions? If not, are you ready to begin?"

*At this point in the instructions the Experimenter showed the S a sample number card to clarify the numeral reading task.

APPENDIX B

MATERIALS

Frequency Ratings by Second-Grade Students of the Words used in the Conceptual Dimension*

Animal		Body Part		Clothing	
Fox	1a4	Finger	2a	Suit	1a3
Leopard	3a	Neck	1b4	Hat	1a2
Cow	1a2	Ear	1a5	Sweater	1b5
Bear	1a2	Arm	2a	Belt	3b
Horse	1a3	Chest	2b	Shirt	2b
Deer	1b1	Lips	2b	Coat	1a2
Lion	1a5	Wrist	2a	Tie	3a
Cat	1a1	Knee	1b	Jacket	3a
Beaver	3b	Head	1a3	Shoe	2a
Camel	1b3	Nose	1b1	Dress	1a2
Wolf	2a	Foot	1b2	Sock	2a
Goat	1a5	Mouth	1b2	Pants	2a
Tiger	1b2	Tongue	2b	Skirt	3a
Dog	1a1	Leg	1b2	Glove	1b5
Zebra	2a	Hand	1a4	Boot	1b5

*Rinsland, H.D. A basic vocabulary of elementary school children. New York: MacMillan Company, 1945.

Symbols and Meanings

1a1 - Word is in the first one hundred of the first five hundred of the first one thousand (Read symbol from right to left.)

1b2 - Word is in the second one hundred of the second five hundred of the first one thousand

2a - Word is in the first half of the second thousand

Vegetable	
Pea	2a
Turnip	1b4
Cabbage	1b5
Celery	3a
Potato	1b3
Rice	2b
Lettuce	1b4
Beet	2b
Radish	4a
Spinach	3b
Corn	1a4
Onion	3b
Bean	2a
Tomato	2b
Carrot	2b

Frequency Ratings by Second-Grade Students of the Words Used in the Semantic Differential Dimensions

Evaluation - Negative		Evaluation - Positive	
Hate	2b	Freedom	5b (Grade 3)
Battle	3a	Peace	3b (Grade 3)
Cut	1a5	Color	1a5
Cold	1a3	Religious	4b (Grade 3)
Last	1a2	Farm	1a5
Kill	1b1	Nice	1a2
Danger	3a	God	1b4
War	2a	Pleasant	3b
Fall	1a5	Fresh	2a
Sick	1a5	Success	5a (Grade 4)
Enemy	3b (Grade 3)	Fine	1a2
Bad	1a4	Enjoy	2a
Trouble	2a	Church	1a5
Burn	2a	Hope	1a2
No	1a2	Friend	1a3
Break	2b	Health	2a
Hurt	1a5	Father	1a2
Lose	4a	True	3b

Potency - Negative	
Voice	2b
Sister	1a2
Young	1b5
Lady	1b5
Poet	3b
Beautiful	1a4
Artist	4a
Baby	1a2
Spring	1a4
Daughter	2b
Sing	1a3
Face	1b1
Summer	1a4
Kiss	2b
Little	1a1
Child	1b3
Flower	1a4
Sweet	1a4

Potency - Positive	
Officer	4a
Strong	1b2
Rock	1b3
Machine	1a5
Army	2b
Train	1a2
Control	3b
Leader	4a
Iron	3b
Law	3a
Mountain	2b
Hard	1a4
Soldier	2b
Tree	1a1
Power	4a
Building	2a
Road	1b2
Ship	1b2

Activity - Negative		Activity - Positive	
Box	1a2	Sailor	2b
Sleep	1a3	Walk	1a4
Paper	1a5	Grow	1a3
Soft	1b2	Club	1b1
Picture	1a4	Action	4a
Old	1a2	Play	1a1
Wait	2a	Fast	1a3
Space	4a	Pull	1b2
Dead	1b5	Stream	2a
Egg	1b1	Laugh	2a
Rest	1b2	Sea	1b2
Nothing	1b4	Member	3b
Quiet	2b	Party	1a4
Stone	2b	Quick	2a
Moon	2a	Drive	2a
Remain	3b	Boy	1a1
Wall	1b4	Surprise	1b1
Slow	3b	Ride	1a2

Frequency Ratings by Second-Grade Students of the Words Used in the Rhyme Dimension

Group I		Group II	
Chew	2b	Spare	4b (Grade 3)
You	1a1	Wear	1a5
True	3b	There	1a1
Few	1b2	Prayer	3b
Blue	1a2	Bear	1a2
Drew	2a	Air	1a5
New	1a2	Tear	3a
Screw	4a	Hair	1a4
Two	1a2	Stare	2b
Glue	3b	Fair	1b3
Flew	1b1	Chair	1a4
Zoo	1a5	Dare	3b
Threw	1a5	Care	1b1
Do	1a1	Share	3b
Shoe	2a	Pair	1a3

APPENDIX C

SHORT-TERM MEMORY TASKS FOR EACH DIMENSION

Short-term Memory Task Using Conceptual Items

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Animal to Body Part				
Experimental				
Fox	Bear	Lion	Camel	Tongue
Leopard	Horse	Cat	Wolf	Leg
Cow	Deer	Beaver	Goat	Hand
Control				
Finger	Arm	Wrist	Nose	Tongue
Neck	Chest	Knee	Foot	Leg
Ear	Lips	Head	Mouth	Hand
Body Part to Animal				
Experimental				
Finger	Arm	Wrist	Nose	Tiger
Neck	Chest	Knee	Foot	Dog
Ear	Lips	Head	Mouth	Zebra
Control				
Fox	Bear	Lion	Camel	Tiger
Leopard	Horse	Cat	Wolf	Dog
Cow	Deer	Beaver	Goat	Zebra
Clothing to Vegetable				
Experimental				
Suit	Belt	Tie	Dress	Bean
Hat	Shirt	Jacket	Sock	Tomato
Sweater	Coat	Shoe	Pants	Carrot
Control				
Pea	Celery	Lettuce	Spinach	Bean
Turnip	Potato	Beet	Corn	Tomato
Cabbage	Rice	Radish	Onion	Carrot
Vegetable to Clothing				
Experimental				
Pea	Celery	Lettuce	Spinach	Skirt
Turnip	Potato	Beet	Corn	Glove
Cabbage	Rice	Radish	Onion	Boot
Control				
Suit	Belt	Tie	Dress	Skirt
Hat	Shirt	Jacket	Socks	Glove
Sweater	Coat	Shoe	Pants	Boot

Short-term Memory Task Using Items From the Evaluation Dimension of the Semantic Differential

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
		Order 1 - Negative to Positive			
Experimental					
Hate	Cold	Danger	Sick	Trouble	Health
Battle	Last	War	Enemy	Burn	Father
Cut	Kill	Fall	Bad	No	True
Control					
Freedom	Religious	God	Success	Church	Health
Peace	Farm	Pleasant	Fine	Hope	Father
Color	Nice	Fresh	Enjoy	Friend	True
		Order 2 - Positive to Negative			
Experimental					
Freedom	Religious	God	Success	Church	Break
Peace	Farm	Pleasant	Fine	Hope	Hurt
Color	Nice	Fresh	Enjoy	Friend	Lose
Control					
Hate	Cold	Danger	Sick	Trouble	Break
Battle	Last	War	Enemy	Burn	Hurt
Cut	Kill	Fall	Bad	No	Lose
		Order 3 - Negative to Positive			
Experimental					
Break	Sick	Trouble	Cold	Danger	God
Hurt	Enemy	Burn	Last	War	Pleasant
Lose	Bad	No	Kill	Fall	Fresh
Control					
Church	Success	Freedom	Nice	Health	God
Friend	Enjoy	Peace	Religious	Father	Pleasant
Hope	Fine	Color	Farm	True	Fresh
		Order 4 - Positive to Negative			
Experimental					
Church	Success	Freedom	Nice	Health	Hate
Friend	Enjoy	Peace	Religious	Father	Battle
Hope	Fine	Color	Farm	True	Cut
Control					
Break	Sick	Trouble	Cold	Danger	Hate
Hurt	Enemy	Burn	Last	War	Battle
Lose	Bad	No	Kill	Fall	Cut

Short-term Memory Task Using Items From the Potency Dimension of the Semantic Differential

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1 - Negative to Positive					
Experimental					
Voice	Lady	Artist	Daughter	Summer	Building
Sister	Poet	Baby	Sing	Kiss	Road
Young	Beautiful	Spring	Face	Little	Ship
Control					
Officer	Machine	Control	Law	Soldier	Building
Strong	Army	Leader	Mountain	Tree	Road
Rock	Train	Iron	Hard	Power	Ship
Order 2 - Positive to Negative					
Experimental					
Officer	Machine	Control	Law	Soldier	Child
Strong	Army	Leader	Mountain	Tree	Flower
Rock	Train	Iron	Hard	Power	Sweet
Control					
Voice	Lady	Artist	Daughter	Summer	Child
Sister	Poet	Baby	Sing	Kiss	Flower
Young	Beautiful	Spring	Face	Little	Sweet
Order 3 - Negative to Positive					
Experimental					
Lady	Summer	Daughter	Sweet	Artist	Machine
Poet	Kiss	Sing	Child	Baby	Army
Beautiful	Little	Face	Flower	Spring	Train
Control					
Building	Control	Law	Soldier	Officer	Machine
Road	Leader	Mountain	Tree	Strong	Army
Ship	Iron	Hard	Power	Rock	Train
Order 4 - Positive to Negative					
Experimental					
Building	Control	Law	Soldier	Officer	Voice
Road	Leader	Mountain	Tree	Strong	Sister
Ship	Iron	Hard	Power	Rock	Young
Control					
Lady	Summer	Daughter	Sweet	Artist	Voice
Poet	Kiss	Sing	Child	Baby	Sister
Beautiful	Little	Face	Flower	Spring	Young

Short-term Memory Task Using Items From the Activity Dimension of the Semantic Differential

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
		Order 1 - Negative to Positive			
Experimental					
Box	Soft	Wait	Egg	Quiet	Boy
Sleep	Picture	Space	Rest	Stone	Surprise
Paper	Old	Dead	Nothing	Moon	Ride
Control					
Sailor	Club	Fast	Laugh	Party	Boy
Walk	Action	Pull	Sea	Quick	Surprise
Grow	Play	Stream	Member	Drive	Ride
		Order 2 - Positive to Negative			
Experimental					
Sailor	Club	Fast	Laugh	Party	Remain
Walk	Action	Pull	Sea	Quick	Wall
Grow	Play	Stream	Member	Drive	Slow
Control					
Box	Soft	Wait	Egg	Quiet	Remain
Sleep	Picture	Space	Rest	Stone	Wall
Paper	Old	Dead	Nothing	Moon	Slow
		Order 3 - Negative to Positive			
Experimental					
Remain	Box	Quiet	Wait	Soft	Action
Wall	Sleep	Moon	Space	Picture	Play
Slow	Paper	Stone	Dead	Old	Club
Control					
Laugh	Stream	Boy	Party	Walk	Action
Sea	Pull	Surprise	Quick	Sailor	Play
Member	Fast	Ride	Drive	Grow	Club
		Order 4 - Positive to Negative			
Experimental					
Laugh	Stream	Boy	Party	Walk	Egg
Sea	Pull	Surprise	Quick	Sailor	Rest
Member	Fast	Ride	Drive	Grow	Nothing
Control					
Remain	Box	Quiet	Wait	Soft	Egg
Wall	Sleep	Moon	Space	Picture	Rest
Slow	Paper	Stone	Dead	Old	Nothing

Short-term Memory Task Using Acoustically Similar Items

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
		Order 1		
Experimental				
Chew	Few	New	Glue	Care
You	Blue	Screw	Flew	Share
True	Drew	Two	Zoo	Pair
Control				
Spare	Prayer	Tear	Fair	Care
Wear	Bear	Hair	Chair	Share
There	Air	Stare	Dare	Pair
		Order 2		
Experimental				
Spare	Prayer	Tear	Fair	Threw
Wear	Bear	Hair	Chair	Do
There	Air	Stare	Dare	Shoe
Control				
Chew	Few	New	Glue	Threw
You	Blue	Screw	Flew	Do
True	Drew	Two	Zoo	Shoe
		Order 3		
Experimental				
Threw	New	Glue	Few	Tear
Do	Screw	Flew	Blue	Hair
Shoe	Two	Zoo	Drew	Stare
Control				
Prayer	Spare	Fair	Care	Tear
Bear	Wear	Chair	Share	Hair
Air	There	Dare	Pair	Stare
		Order 4		
Experimental				
Prayer	Spare	Fair	Care	Chew
Bear	Wear	Chair	Share	You
Air	There	Dare	Pair	True
Control				
Threw	New	Glue	Few	Chew
Do	Screw	Flew	Blue	You
Shoe	Two	Zoo	Drew	True

APPENDIX D

RAW DATA

Number of Words Correctly Recalled on Each Trial

Conceptual Dimension

Second Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	3	1	0	0	2
	2	3	0	1	0	3
	3	3	1	1	0	2
	4	3	1	1	0	2
	5	3	0	3	1	3
	6	3	2	1	2	2
	7	2	2	2	1	2
	8	3	1	1	0	3
	9	3	2	1	0	3
	10	3	2	1	3	2
Order 2:	11	3	0	2	1	1
	12	2	2	0	0	2
	13	3	1	1	2	3
	14	2	1	0	0	3
	15	2	2	1	1	2
	16	3	0	0	2	2
	17	3	1	1	0	3
	18	3	0	2	0	2
	19	3	0	2	0	3
	20	2	2	0	1	2
Order 3:	21	2	2	1	2	3
	22	3	2	2	2	3
	23	3	2	2	1	1
	24	3	0	2	2	3
	25	3	1	0	2	2
	26	3	1	1	1	3
	27	2	2	1	0	3
	28	3	1	2	1	1
	29	3	3	2	1	2
	30	3	3	1	3	3
Order 4:	31	2	2	1	2	3
	32	3	0	0	0	1
	33	3	2	0	2	3
	34	3	0	2	1	2
	35	3	1	2	1	3
	36	2	1	1	1	2
	37	3	0	0	1	2
	38	2	0	0	0	2
	39	3	1	0	3	2
	40	3	0	1	3	3

Number of Words Correctly Recalled on Each Trial

Conceptual Dimension

Second Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	2	2	0	1	0
	2	3	0	0	2	1
	3	3	1	1	0	1
	4	2	1	1	1	1
	5	3	1	1	0	1
	6	3	0	0	0	0
	7	3	1	2	0	2
	8	3	1	1	1	2
	9	3	0	1	1	0
	10	3	3	0	0	1
Order 2:	11	3	0	0	2	1
	12	3	1	0	0	1
	13	3	2	2	2	1
	14	3	1	1	0	1
	15	2	0	2	0	1
	16	3	1	1	1	2
	17	3	3	1	2	2
	18	2	1	0	1	0
	19	3	1	2	0	1
	20	3	1	2	1	1
Order 3:	21	3	1	1	1	0
	22	3	1	1	0	2
	23	3	1	0	1	2
	24	3	0	2	1	0
	25	3	0	2	3	2
	26	3	2	2	1	1
	27	3	1	1	1	1
	28	3	0	1	1	1
	29	2	1	0	0	2
	30	3	0	0	2	2
Order 4:	31	2	2	3	1	0
	32	3	2	2	1	2
	33	3	1	1	2	2
	34	3	0	2	1	0
	35	3	2	1	2	0
	36	3	2	1	3	1
	37	2	1	0	1	2
	38	2	2	1	2	0
	39	3	1	1	1	3
	40	3	3	1	3	3

Number of Words Correctly Recalled on Each Trial

Conceptual Dimension

Sixth Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	3	2	2	2	3
	2	3	1	3	2	2
	3	3	3	3	2	3
	4	3	1	2	2	3
	5	3	2	2	2	3
	6	3	1	3	2	3
	7	3	2	2	2	3
	8	3	1	2	2	2
	9	3	2	3	1	2
	10	3	1	3	2	2
Order 2:	11	3	1	0	1	3
	12	3	1	2	2	3
	13	3	1	2	3	3
	14	3	2	1	2	1
	15	3	3	1	2	3
	16	3	2	2	1	2
	17	3	2	1	1	3
	18	3	3	2	1	3
	19	3	2	1	2	3
	20	3	3	2	3	3
Order 3:	21	2	2	3	2	3
	22	3	2	1	3	2
	23	3	0	2	1	3
	24	3	2	3	2	3
	25	3	2	2	2	3
	26	3	1	2	1	3
	27	3	1	2	2	3
	28	3	2	2	2	3
	29	3	1	2	1	3
	30	3	3	3	2	2
Order 4:	31	3	3	2	1	3
	32	3	2	0	1	3
	33	3	3	2	1	2
	34	3	3	2	2	3
	35	3	1	2	0	3
	36	3	1	2	2	3
	37	3	3	2	2	3
	38	3	3	2	2	3
	39	3	3	3	1	3
	40	3	3	3	2	1

Number of Words Correctly Recalled on Each Trial

Conceptual Dimension

Sixth Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	3	3	2	1	1
	2	2	2	0	2	2
	3	3	2	0	2	2
	4	3	2	1	1	1
	5	3	3	1	1	1
	6	3	1	1	3	2
	7	3	2	1	2	2
	8	3	2	2	2	2
	9	3	1	1	1	1
	10	3	1	0	0	2
Order 2:	11	3	3	3	2	2
	12	3	1	2	2	2
	13	3	1	3	3	2
	14	3	2	2	1	1
	15	3	2	2	2	1
	16	3	2	2	2	2
	17	3	2	2	2	2
	18	3	2	3	3	2
	19	2	1	1	3	1
	20	3	1	3	1	2
Order 3:	21	3	1	1	1	1
	22	3	2	1	2	2
	23	3	1	0	2	1
	24	3	3	1	2	0
	25	3	3	1	2	2
	26	2	2	2	0	2
	27	3	3	2	2	1
	28	3	2	2	2	2
	29	3	3	1	2	2
	30	2	2	2	0	2
Order 4:	31	3	1	2	2	2
	32	3	3	1	0	2
	33	3	2	3	0	0
	34	3	1	1	1	2
	35	3	3	2	1	2
	36	3	2	3	2	3
	37	3	1	2	0	2
	38	3	1	2	0	2
	39	3	3	3	1	2
	40	2	3	2	2	1

Number of Words Correctly Recalled on Each Trial

Evaluation Dimension

Second Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	3	1	0	0	1	3
	2	3	1	2	1	1	2
	3	3	1	3	0	2	2
	4	3	0	2	1	0	2
	5	3	0	2	2	3	3
	6	3	1	1	0	1	2
	7	2	1	1	1	0	2
	8	3	1	2	1	2	2
	9	3	0	0	0	1	2
	10	2	1	1	0	0	2
Order 2:	11	3	2	0	1	2	3
	12	2	2	0	0	0	2
	13	3	1	2	1	2	2
	14	3	1	1	1	0	1
	15	3	2	1	1	0	0
	16	2	1	1	1	2	2
	17	2	0	1	0	1	0
	18	3	0	1	0	1	3
	19	2	3	0	0	2	0
	20	3	3	2	0	2	3
Order 3:	21	3	2	1	0	1	3
	22	2	1	2	1	2	2
	23	2	1	1	2	1	1
	24	2	1	2	2	0	1
	25	3	1	1	0	1	3
	26	3	3	2	0	0	3
	27	2	2	3	2	0	3
	28	3	2	1	0	2	2
	29	3	3	1	2	2	0
	30	3	1	0	2	1	2
Order 4:	31	3	1	1	2	0	3
	32	3	2	1	2	1	2
	33	2	1	1	2	1	1
	34	3	1	2	2	0	3
	35	1	2	0	1	3	3
	36	3	1	0	1	1	0
	37	2	2	1	2	2	2
	38	2	2	1	1	2	3
	39	2	1	2	0	1	2
	40	3	2	1	2	2	3

Number of Words Correctly Recalled on Each Trial

Evaluation Dimension

Second Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	2	1	1	0	2	0
	2	2	1	1	0	3	2
	3	2	2	0	0	1	0
	4	2	2	1	1	1	2
	5	3	2	1	0	0	1
	6	2	1	2	0	0	1
	7	2	1	1	1	1	0
	8	2	2	1	0	1	1
	9	3	2	1	0	3	3
	10	2	1	3	2	1	1
Order 2:	11	2	0	2	3	1	0
	12	2	1	2	0	2	2
	13	3	1	1	0	1	2
	14	2	3	3	2	1	0
	15	3	0	0	1	1	0
	16	2	1	1	0	1	2
	17	3	1	3	3	3	1
	18	2	2	0	1	0	1
	19	3	1	2	1	1	1
	20	2	0	0	0	2	2
Order 3:	21	3	2	1	1	2	2
	22	3	0	3	1	1	1
	23	2	2	0	2	2	1
	24	2	1	2	0	0	1
	25	3	3	1	2	3	2
	26	3	1	2	1	2	2
	27	2	0	2	2	3	2
	28	2	2	2	3	2	0
	29	3	2	2	2	2	1
	30	3	1	2	2	1	1
Order 4:	31	3	2	0	1	0	1
	32	2	0	1	1	0	1
	33	2	1	0	1	1	0
	34	3	3	0	1	0	0
	35	2	0	1	1	0	0
	36	3	1	1	2	0	1
	37	2	3	0	1	1	1
	38	2	0	1	1	0	1
	39	3	0	0	2	0	2
	40	3	3	1	1	1	2

Number of Words Correctly Recalled on Each Trial

Evaluation Dimension

Sixth Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	3	2	2	3	2	2
	2	3	1	3	2	2	3
	3	3	1	0	2	1	3
	4	3	3	2	3	2	2
	5	3	1	0	2	1	3
	6	3	1	2	3	1	2
	7	3	2	3	2	1	0
	8	3	2	1	1	2	3
	9	3	1	2	3	3	3
	10	2	2	2	2	3	3
Order 2:	11	3	3	1	1	2	3
	12	3	3	1	1	0	0
	13	3	1	1	1	3	2
	14	3	3	1	2	1	2
	15	3	2	1	1	1	3
	16	3	2	1	1	3	3
	17	3	2	2	1	3	3
	18	3	2	3	1	2	3
	19	3	2	3	3	0	3
	20	3	3	0	1	1	2
Order 3:	21	3	3	1	0	0	2
	22	3	3	2	3	2	3
	23	2	1	2	1	1	3
	24	3	3	1	3	2	1
	25	3	2	3	2	1	3
	26	3	2	1	1	2	3
	27	3	2	0	0	1	2
	28	3	1	3	0	1	2
	29	3	3	2	1	2	2
	30	3	3	3	3	2	3
Order 4:	31	3	2	2	2	2	3
	32	2	3	2	3	3	3
	33	1	2	3	0	2	3
	34	3	1	3	3	2	2
	35	3	1	2	2	2	3
	36	3	2	1	2	1	3
	37	3	1	1	1	2	2
	38	3	2	2	2	1	0
	39	2	1	2	2	2	3
	40	2	1	2	2	2	3

Number of Words Correctly Recalled on Each Trial

Evaluation Dimension

Sixth Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	3	3	2	1	0	1
	2	3	2	3	2	1	1
	3	3	1	3	0	2	2
	4	2	3	0	1	0	1
	5	2	2	2	0	2	0
	6	3	2	2	2	2	2
	7	3	2	1	0	1	2
	8	3	2	1	2	2	2
	9	3	2	3	3	3	2
	10	2	2	1	1	1	2
Order 2:	11	3	1	2	0	0	2
	12	3	3	2	3	3	2
	13	3	2	1	0	0	2
	14	2	2	1	2	0	3
	15	3	1	2	3	2	0
	16	3	1	3	0	2	2
	17	2	1	3	2	0	1
	18	3	2	0	1	0	2
	19	3	1	3	3	3	3
	20	3	0	1	1	1	2
Order 3:	21	3	2	3	0	1	1
	22	3	2	3	2	1	2
	23	3	2	2	1	0	0
	24	2	3	3	1	2	2
	25	2	3	2	2	1	1
	26	3	3	3	3	2	2
	27	2	1	0	2	2	0
	28	3	2	2	2	3	2
	29	2	2	2	2	2	2
	30	3	1	2	3	3	2
Order 4:	31	3	0	2	2	2	2
	32	3	3	2	3	3	2
	33	3	3	2	1	3	1
	34	3	2	1	1	2	2
	35	3	1	1	0	1	2
	36	3	3	1	1	1	1
	37	2	3	0	2	3	2
	38	3	3	1	1	2	2
	39	3	3	1	3	2	1
	40	3	3	2	1	2	2

Number of Words Correctly Recalled on Each Trial

Potency Dimension

Second Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	2	1	2	2	0	0
	2	3	0	0	1	0	2
	3	3	3	2	2	3	2
	4	3	0	1	0	1	1
	5	3	3	2	0	1	0
	6	3	1	1	1	0	0
	7	3	3	2	2	1	2
	8	2	3	3	2	2	3
	9	3	1	2	0	3	2
	10	3	2	3	0	0	0
Order 2:	11	2	0	0	1	1	2
	12	2	1	1	1	2	1
	13	3	3	1	3	0	2
	14	3	2	0	0	1	2
	15	2	2	0	1	0	3
	16	3	3	1	3	3	2
	17	2	1	0	2	1	2
	18	2	2	0	1	1	2
	19	3	3	0	1	0	2
	20	3	1	2	1	1	3
Order 3:	21	3	1	0	1	2	3
	22	3	3	0	2	2	3
	23	2	1	1	1	1	2
	24	2	2	2	0	2	1
	25	3	1	2	1	2	0
	26	3	2	1	0	3	0
	27	3	1	1	1	2	1
	28	3	0	0	1	2	1
	29	3	2	0	0	2	2
	30	3	3	2	0	0	0
Order 4:	31	3	2	2	0	2	2
	32	3	2	1	2	2	0
	33	3	3	1	1	3	3
	34	2	2	0	3	3	3
	35	3	0	0	1	1	0
	36	1	1	2	3	2	1
	37	2	2	0	0	2	2
	38	3	3	1	0	2	0
	39	2	1	2	0	1	2
	40	2	1	1	3	0	1

Number of Words Correctly Recalled on Each Trial

Potency Dimension

Second Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	2	2	1	0	3	1
	2	3	0	1	0	1	2
	3	2	2	0	2	0	0
	4	3	1	2	3	2	0
	5	3	1	2	3	1	2
	6	1	2	1	2	2	0
	7	3	3	0	3	0	2
	8	3	1	0	1	1	1
	9	3	0	0	2	2	2
	10	2	2	2	3	3	3
Order 2:	11	3	0	0	2	1	2
	12	2	1	1	1	2	0
	13	3	0	1	0	1	2
	14	1	2	2	1	2	3
	15	3	2	0	1	0	0
	16	3	3	3	0	0	0
	17	2	1	2	1	2	0
	18	2	2	3	2	0	3
	19	3	3	2	2	2	1
	20	2	2	2	1	2	1
Order 3:	21	2	3	0	0	1	0
	22	2	1	0	2	1	0
	23	2	2	2	1	0	2
	24	3	0	1	3	2	2
	25	2	1	0	3	2	0
	26	3	2	1	1	1	3
	27	2	2	0	0	2	2
	28	3	2	2	0	1	2
	29	2	3	2	3	0	0
	30	2	2	1	1	1	3
Order 4:	31	3	2	0	1	2	0
	32	2	2	1	1	2	2
	33	2	1	2	1	2	3
	34	2	2	1	0	3	0
	35	2	1	1	3	2	2
	36	3	2	2	2	3	3
	37	3	2	1	1	2	2
	38	2	2	2	1	2	1
	39	3	1	2	2	1	0
	40	3	0	2	3	3	3

Number of Words Correctly Recalled on Each Trial

Potency Dimension

Sixth Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	3	3	1	3	2	3
	2	3	3	2	2	2	0
	3	3	0	2	1	0	0
	4	3	3	1	3	3	2
	5	3	3	2	2	1	3
	6	3	3	2	0	2	2
	7	2	3	2	3	1	3
	8	3	3	2	1	1	3
	9	2	2	1	2	2	3
	10	3	3	2	2	2	3
Order 2:	11	3	3	0	3	2	2
	12	3	2	1	2	2	3
	13	2	1	3	2	3	1
	14	3	3	1	2	3	3
	15	3	1	2	0	1	2
	16	2	2	0	3	2	2
	17	3	2	3	3	2	3
	18	3	3	3	3	1	3
	19	3	2	2	1	1	2
	20	3	3	1	3	3	0
Order 3:	21	3	3	2	0	1	3
	22	3	2	2	3	3	3
	23	2	2	1	0	2	2
	24	3	3	0	3	2	3
	25	3	2	2	2	3	3
	26	3	3	3	3	2	2
	27	3	1	2	3	3	3
	28	3	3	2	0	2	1
	29	3	3	2	3	2	3
	30	3	3	2	1	2	2
Order 4:	31	3	2	2	2	2	3
	32	3	3	2	1	2	3
	33	3	3	2	2	3	3
	34	3	2	2	2	1	3
	35	3	3	2	3	2	3
	36	3	3	0	2	2	3
	37	3	3	1	0	1	3
	38	3	2	0	3	1	0
	39	2	3	2	2	2	3
	40	3	3	3	2	1	1

Number of Words Correctly Recalled on Each Trial

Potency Dimension

Sixth Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	2	2	2	2	0	3
	2	3	1	2	3	2	3
	3	3	2	3	3	0	2
	4	3	1	3	2	3	3
	5	2	1	2	2	2	1
	6	3	2	0	2	3	3
	7	3	1	1	3	3	2
	8	2	2	1	2	0	2
	9	3	2	3	1	0	1
	10	3	3	2	0	2	1
Order 2:	11	2	2	2	2	2	2
	12	3	1	1	1	2	3
	13	3	2	2	2	0	3
	14	3	3	3	1	3	2
	15	3	3	0	0	2	2
	16	3	3	3	1	3	2
	17	3	3	1	1	2	2
	18	2	3	3	3	1	2
	19	3	3	1	2	2	3
	20	3	3	2	3	2	2
Order 3:	21	3	3	2	1	0	1
	22	3	3	2	3	1	1
	23	3	2	3	1	2	3
	24	3	2	2	2	1	1
	25	3	3	2	3	2	2
	26	3	2	3	1	2	2
	27	3	3	3	3	2	2
	28	3	3	2	2	2	2
	29	3	2	2	2	2	3
	30	3	2	2	0	2	2
Order 4:	31	2	1	2	3	3	3
	32	2	3	1	0	2	2
	33	3	2	1	1	2	2
	34	3	3	3	3	3	2
	35	3	3	2	3	2	2
	36	3	1	3	1	3	3
	37	2	2	2	3	2	3
	38	3	2	3	3	3	3
	39	3	2	2	2	2	2
	40	2	3	0	3	2	3

Number of Words Correctly Recalled on Each Trial

Activity Dimension

Second Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	3	1	1	2	0	1
	2	3	0	1	1	0	1
	3	3	2	1	2	1	3
	4	2	0	1	2	1	1
	5	3	0	1	2	1	1
	6	3	1	1	2	0	0
	7	2	2	1	0	0	2
	8	2	2	0	0	1	3
	9	2	0	1	0	1	1
	10	3	0	1	3	0	0
Order 2:	11	3	0	3	0	1	2
	12	2	2	0	1	2	1
	13	3	0	0	2	1	1
	14	1	0	0	1	1	1
	15	3	1	1	1	0	1
	16	2	3	1	0	3	2
	17	3	3	2	2	2	1
	18	3	0	1	0	2	0
	19	3	1	0	0	2	2
	20	3	2	3	2	0	3
Order 3:	21	2	0	2	1	0	3
	22	3	0	0	2	0	2
	23	2	2	0	0	2	1
	24	3	2	0	1	1	2
	25	2	2	0	2	2	0
	26	2	1	1	2	0	1
	27	1	3	2	1	2	3
	28	2	3	2	2	3	3
	29	3	2	1	3	1	2
	30	3	3	3	1	0	2
Order 4:	31	3	0	2	0	0	0
	32	2	2	1	1	2	1
	33	3	0	2	1	3	0
	34	2	1	1	0	2	2
	35	2	0	2	2	0	1
	36	2	2	2	1	2	2
	37	2	2	2	2	0	2
	38	2	2	2	2	1	2
	39	3	1	3	2	1	1
	40	3	2	1	1	3	2

Number of Words Correctly Recalled on Each Trial

Activity Dimension

Second Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	2	2	1	0	2	2
	2	3	1	2	1	1	2
	3	2	0	1	0	1	1
	4	3	3	3	3	1	2
	5	2	0	1	1	1	1
	6	2	2	3	0	2	2
	7	1	3	0	0	3	2
	8	3	3	0	2	1	3
	9	3	1	1	2	1	1
	10	1	1	0	2	2	2
Order 2:	11	2	1	0	2	0	1
	12	3	2	0	3	2	2
	13	2	0	2	3	1	2
	14	3	0	2	1	0	2
	15	2	0	1	0	1	0
	16	3	1	1	0	0	2
	17	2	2	2	0	1	1
	18	3	1	1	1	1	2
	19	3	3	1	1	2	2
	20	2	2	1	1	1	1
Order 3:	21	2	0	1	3	1	0
	22	1	1	3	2	1	0
	23	3	1	2	1	2	1
	24	1	1	2	1	1	1
	25	3	0	1	1	0	1
	26	2	2	1	2	0	2
	27	3	0	2	1	1	2
	28	3	0	2	1	0	0
	29	3	2	2	1	1	0
	30	3	1	3	2	0	2
Order 4:	31	2	3	1	0	0	0
	32	2	2	0	2	0	0
	33	3	3	1	1	0	1
	34	1	1	1	1	2	1
	35	2	1	0	0	1	2
	36	1	2	1	1	0	1
	37	2	2	2	1	0	1
	38	2	2	0	2	1	2
	39	3	2	1	1	1	1
	40	3	1	0	2	0	1

Number of Words Correctly Recalled on Each Trial

Activity Dimension

Sixth Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	3	1	1	3	2	2
	2	3	0	2	3	2	1
	3	2	2	2	2	0	3
	4	3	1	0	2	0	3
	5	3	3	2	3	2	2
	6	3	0	2	0	1	3
	7	3	0	2	2	0	2
	8	3	3	2	2	1	1
	9	3	0	3	0	0	3
	10	3	2	2	2	1	1
Order 2:	11	3	3	0	3	1	3
	12	2	2	2	3	2	3
	13	2	3	0	2	3	3
	14	3	3	0	2	1	3
	15	2	2	1	0	3	1
	16	3	3	2	3	3	2
	17	2	1	1	2	3	2
	18	3	3	3	3	2	3
	19	3	3	1	3	2	2
	20	3	3	3	3	2	3
Order 3:	21	3	3	3	2	3	3
	22	3	3	1	2	2	3
	23	3	3	3	3	3	2
	24	3	2	3	2	2	3
	25	2	2	1	1	1	1
	26	3	3	3	3	3	3
	27	3	3	3	2	2	3
	28	3	3	1	3	3	3
	29	2	2	1	2	2	2
	30	2	3	2	2	2	2
Order 4:	31	2	2	3	2	1	2
	32	3	1	3	3	1	3
	33	3	3	2	1	2	1
	34	3	3	2	2	3	3
	35	3	0	3	2	3	3
	36	3	3	2	3	2	2
	37	3	2	2	0	2	1
	38	3	2	2	2	2	2
	39	3	1	2	3	1	2
	40	3	2	2	3	3	3

Number of Words Correctly Recalled on Each Trial

Activity Dimension

Sixth Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Order 1:	1	3	3	0	1	2	1
	2	3	2	3	0	3	2
	3	3	0	3	1	2	2
	4	3	3	1	0	3	3
	5	3	2	1	3	0	3
	6	3	1	1	0	2	2
	7	3	1	3	1	3	2
	8	3	2	0	3	2	3
	9	3	3	2	3	3	3
	10	3	2	3	0	2	1
Order 2:	11	3	2	2	2	2	2
	12	3	3	2	3	2	3
	13	3	3	3	2	2	2
	14	3	0	3	0	0	0
	15	3	2	1	2	3	3
	16	2	1	1	0	2	1
	17	2	1	1	1	2	1
	18	3	2	1	2	2	2
	19	3	1	2	1	0	1
	20	3	1	3	2	1	2
Order 3:	21	3	2	1	1	2	1
	22	3	3	2	2	3	2
	23	3	3	3	1	2	1
	24	3	3	2	2	2	3
	25	3	1	3	2	2	3
	26	2	3	2	3	2	3
	27	3	3	2	2	3	3
	28	3	2	3	1	3	1
	29	3	3	2	3	3	3
	30	2	2	1	2	2	1
Order 4:	31	3	1	3	1	3	3
	32	3	3	0	3	3	3
	33	3	2	3	1	2	2
	34	3	2	2	2	3	1
	35	3	3	3	0	1	2
	36	2	3	2	1	1	2
	37	2	3	3	3	2	2
	38	2	3	0	2	2	2
	39	3	0	0	1	1	2
	40	2	2	2	0	2	3

Number of Words Correctly Recalled on Each Trial

Rhyme Dimension

Second Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	3	1	0	1	1
	2	2	1	2	0	2
	3	3	0	0	1	0
	4	2	1	2	1	0
	5	2	0	0	2	2
	6	2	1	2	2	2
	7	2	1	1	1	2
	8	2	2	0	1	3
	9	2	1	0	2	0
	10	2	2	3	2	2
Order 2:	11	2	3	1	2	3
	12	2	2	3	0	3
	13	3	2	2	0	2
	14	2	3	1	1	0
	15	3	3	0	1	2
	16	3	3	2	3	3
	17	3	1	2	1	0
	18	3	2	1	0	0
	19	2	3	3	1	2
	20	2	1	0	1	0
Order 3:	21	2	0	1	1	2
	22	3	3	1	1	3
	23	3	2	3	1	3
	24	3	1	3	2	3
	25	3	1	2	1	2
	26	2	2	2	2	3
	27	3	2	1	0	2
	28	2	1	1	1	3
	29	3	2	2	1	3
	30	3	2	0	1	3
Order 4:	31	2	3	0	1	0
	32	2	2	1	0	3
	33	2	0	1	1	2
	34	2	2	2	1	3
	35	2	1	0	0	0
	36	2	1	3	1	3
	37	2	1	1	1	2
	38	2	3	2	1	2
	39	3	1	2	2	3
	40	3	2	3	0	2

Number of Words Correctly Recalled on Each Trial

Rhyme Dimension

Second Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	1	1	2	2	1
	2	3	3	0	1	1
	3	3	1	2	2	0
	4	2	1	0	1	1
	5	2	3	0	2	2
	6	3	2	2	0	1
	7	2	1	2	2	0
	8	2	2	2	0	1
	9	3	1	1	2	1
	10	2	2	1	1	1
Order 2:	11	2	1	1	1	2
	12	2	1	1	0	1
	13	2	2	0	0	0
	14	3	0	2	2	1
	15	2	1	2	1	2
	16	3	2	2	2	1
	17	1	2	2	2	1
	18	3	0	1	2	0
	19	3	1	0	2	1
	20	2	1	2	2	2
Order 3:	21	3	1	0	0	0
	22	3	2	1	2	1
	23	2	1	1	2	0
	24	2	2	1	2	1
	25	3	1	2	2	1
	26	3	2	1	0	0
	27	3	0	2	1	1
	28	3	2	1	2	1
	29	3	2	1	1	2
	30	3	1	3	2	3
Order 4:	31	2	2	0	1	2
	32	3	1	2	2	2
	33	2	1	2	0	0
	34	2	1	2	1	1
	35	3	2	2	2	1
	36	2	2	0	1	0
	37	3	2	2	1	0
	38	2	2	2	1	1
	39	3	3	1	0	1
	40	3	3	3	0	1

Number of Words Correctly Recalled on Each Trial

Rhyme Dimension

Sixth Grade - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	2	1	2	1	3
	2	3	3	2	3	3
	3	2	1	0	1	0
	4	3	1	2	3	3
	5	2	3	2	2	3
	6	2	1	2	2	2
	7	3	1	2	2	3
	8	3	0	3	3	3
	9	3	3	1	2	3
	10	2	2	3	0	3
Order 2:	11	2	2	0	1	1
	12	3	3	2	0	3
	13	2	1	0	0	2
	14	3	3	2	2	3
	15	2	2	0	1	1
	16	3	1	2	2	2
	17	3	3	0	2	3
	18	3	2	1	1	3
	19	3	3	2	2	3
	20	3	1	2	1	3
Order 3:	21	2	2	3	1	3
	22	3	1	3	1	0
	23	3	3	2	2	2
	24	3	2	2	3	0
	25	3	2	2	0	3
	26	3	1	2	2	3
	27	3	1	1	0	3
	28	3	2	3	2	3
	29	3	1	1	1	2
	30	2	2	1	1	2
Order 4:	31	3	3	2	1	3
	32	3	1	3	0	3
	33	3	1	2	2	2
	34	2	1	1	2	3
	35	2	1	1	2	3
	36	3	3	2	2	3
	37	3	2	2	3	3
	38	2	3	2	2	2
	39	2	0	1	1	2
	40	2	3	2	1	2

Number of Words Correctly Recalled on Each Trial

Rhyme Dimension

Sixth Grade - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	3	2	2	1	2
	2	3	1	1	2	2
	3	3	3	1	0	1
	4	2	3	2	2	2
	5	3	2	3	2	2
	6	2	2	2	0	3
	7	3	3	0	2	0
	8	2	3	1	3	1
	9	3	2	3	2	2
	10	3	2	2	3	1
Order 2:	11	3	1	2	2	3
	12	3	2	3	2	1
	13	2	2	2	2	2
	14	3	1	2	1	2
	15	3	2	3	2	2
	16	3	2	1	3	2
	17	3	1	2	3	1
	18	3	0	2	2	2
	19	3	1	1	2	1
	20	3	1	1	1	2
Order 3:	21	3	3	2	2	2
	22	3	3	1	2	1
	23	3	3	1	2	1
	24	2	2	2	2	2
	25	3	1	3	3	0
	26	3	2	3	2	1
	27	3	1	3	2	1
	28	2	3	0	1	0
	29	3	2	2	3	2
	30	3	2	2	0	1
Order 4:	31	3	1	3	1	2
	32	3	3	1	1	1
	33	3	2	3	3	3
	34	3	2	2	1	2
	35	3	2	2	2	2
	36	3	3	3	2	2
	37	3	0	1	1	2
	38	3	1	2	0	2
	39	2	2	3	0	1
	40	3	2	2	2	1

Number of Words Correctly Recalled on Each Trial

Rhyme Dimension

Adult - Experimental

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	3	2	1	2	2
	2	3	3	3	0	0
	3	2	3	2	2	3
	4	3	2	2	3	3
	5	3	2	2	3	3
	6	3	3	3	3	3
	7	3	3	3	3	3
	8	3	3	2	3	2
	9	3	3	1	2	2
	10	3	3	3	1	3
Order 2:	11	3	2	3	1	3
	12	3	3	1	0	3
	13	3	2	2	2	3
	14	3	2	3	3	3
	15	3	2	2	1	3
	16	2	2	1	1	3
	17	3	3	2	1	3
	18	3	3	3	3	3
	19	3	3	2	2	2
	20	3	2	3	3	3
Order 3:	21	3	3	2	2	3
	22	3	3	3	3	3
	23	3	3	1	3	3
	24	3	3	2	2	3
	25	3	3	3	1	3
	26	3	2	2	2	3
	27	3	3	2	2	3
	28	3	3	3	3	3
	29	3	3	2	3	2
	30	3	3	3	3	3
Order 4:	31	3	3	3	3	3
	32	2	3	3	3	2
	33	3	2	1	3	2
	34	3	3	3	3	2
	35	2	2	1	2	2
	36	3	3	3	3	3
	37	3	3	3	2	3
	38	3	3	3	3	3
	39	3	3	3	3	2
	40	3	3	3	2	2

Number of Words Correctly Recalled on Each Trial

Rhyme Dimension

Adult - Control

	S	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Order 1:	1	3	2	3	2	2
	2	3	3	2	0	3
	3	3	3	2	2	0
	4	3	2	3	2	2
	5	3	1	1	2	2
	6	3	2	3	3	3
	7	3	2	3	1	1
	8	2	2	2	3	2
	9	3	2	3	2	3
	10	3	3	2	2	3
Order 2:	11	3	2	0	2	0
	12	3	2	1	3	3
	13	3	3	3	2	3
	14	3	3	3	1	2
	15	3	2	2	2	2
	16	2	0	3	1	3
	17	3	2	2	1	3
	18	3	3	2	3	2
	19	2	2	2	2	3
	20	2	3	3	2	3
Order 3:	21	3	3	1	0	3
	22	3	3	2	3	3
	23	3	3	3	2	1
	24	3	3	3	3	3
	25	3	2	2	2	3
	26	3	3	3	2	3
	27	3	1	2	3	2
	28	3	0	2	2	2
	29	3	3	3	2	2
	30	3	3	2	2	1
Order 4:	31	3	3	3	2	2
	32	3	3	1	2	2
	33	3	3	1	1	2
	34	3	2	3	2	2
	35	3	2	1	3	3
	36	3	1	3	3	3
	37	3	3	3	3	2
	38	3	3	3	3	2
	39	3	3	3	3	1
	40	3	3	3	3	2